AN ASSESSMENT OF RECREATIONAL CARRYING CAPACITY AT INFANTA, SOUTH CAPE

by

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RESEARCH REPORT 57

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ABSTRACT

A proposal to develop 100 additional residential erven at Infanta, a holiday township on the South Cape coast, prompted this study. Current pressure of human activities imposed on the Infanta coastal and estuarine environment during peak holiday periods is determined from questionnaire analysis and direct observations. Projections of potential recreational demand anticipated at the proposed higher level of development are made. An assessment of recreational carrying capacity indicates in broad terms what levels of use are acceptable for the different recreational activities pursued in the area. At the present population pressure these levels are already attained or exceeded for most activities.

Major physical, ecological and social constraints for further township development are identified. The beach and swimming area, as well as ancillary shore facilities for boats, are already inadequate to support current recreational pressure. Increased recreational pressure will result in competition for water space and conflicts between different recreational interest groups will occur. Surveys conducted during this study suggest that particular bait and shellfish organisms (e.g. Alikreukel) are already overexploited. There is also evidence of a decline in the numbers and size of fish caught. At one recreation site, bank erosion and destruction of salt marsh vegetation is indicative of heavy boating and watersports activities. An increased holiday population would result in overcrowding at recreation sites. This would reduce the

quality of the recreation experience for both the present holidaymakers and newcomers to the area.

It is concluded that both the environmental resources and existing man-made amenities in the area are already stressed by present recreational pressure and cannot support an increased holiday population during peak holiday periods. Increased development will destroy the attributes which attracted development in the first instance. Additional township development which will increase population numbers during peak holiday periods should not be permitted.

It is recommended that an evaluation of present recreational pressure, projections of potential recreational demand and an assessment of recreational carrying capacity based on physical, ecological and social constraints should be a routine procedure in the consideration of applications for the extension or establishment of coastal townships.

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CHAPTER 1 : INTRODUCTION

1.1 Introduction to the Topic

The coastal zone is an exceptional attraction for most people because of its diversity of landscape, aesthetic attributes and potential for leisure and recreational activities. The South African coastal and estuarine environment offers a diversity of recreational opportunities and during holiday seasons people flock to the coastal resorts to participate in outdoor activities such as swimming, surfing and sport angling or simply to relax and enjoy the pleasant and healthy surroundings.

In most countries, including South Africa, rapid population increases and improved economic circumstances, as well as the trend towards shorter working hours and more leisure time, have led to greater demands for recreational outlets along the coast. This necessarily implies greater human pressure on all components of the coast but in particular on estuaries because of the recreational value of their water surfaces and immediate environment (Heydorn and Tinley, 1980, p. 6).

Of all land, coastal land is undoubtedly in the greatest demand in South Africa today (Hey, 1983). As a result, coastal zone property suitable for recreational development has become scarce and prices are high. This is clearly illustrated in a recent newspaper article which reported the following:

> 'More than R3 million of coastal plots were sold at two Cape auctions this week. ... At Witsands the Langeberg Divisional Council sold 84 plots with good sea views for a total of just under R2 million .... Auctioneers claim that demand for coastal plots is higher than last year.' (Argus, 31 December 1983.)

O'Rourke (1973, p. 29) makes the following pertinent comments with regard to increasing development and recreational use along the Australian coastal zone:

> 'Competition for scarce coastal resources is evident, various parts of the environment are threatened by pressures of congestion, overcrowding and disfigurement and whilst the public is becoming increasingly aware of the impending danger of continued deterioration in environmental quality they are less aware of the diminution of resources which it will be necessary to conserve if present trends of increasing leisure time, affluence and mobility are maintained.'

These observations are equally relevant in the South African context.

Despite the great demand for coastal property, many townships along the southern Cape coast are relatively undeveloped. Figures obtained from the erf registers maintained at the Department of Local Government, reveal that by 1980, less than 40% of the erven in most coastal towns between Rooi-Els and the Gouritz River mouth had been developed. This suggests that many plots are being bought for speculative purposes.

This lack of development also raises the question of whether a 'second' holiday home is in fact the most

desirable form of holiday accommodation. Purchasing a plot or holiday home along the coast is now prohibitively expensive for most people (Cape Coastal Survey, 1973, p. 51).

A survey of the Cape coast, conducted in the early 1970's, addresses the problem of increasing recreational demands in the coastal zone. One of the major points stressed in this document was that too much emphasis has been placed on the provision of recreational facilities, in the form of minimally developed holiday townships and this has not satisfied the demand for recreational accommodation. Consequently, it is recognized that there is a great need for the establishment, by both private and public bodies, of a diversity of accommodation types (Cape Coastal Survey, 1973, p. 121).

Various government authorities have expressed concern over the uncontrolled haphazard development along the South African coastline. In recent years it has been recognized that inappropriate development without due consideration of the environment, has in certain coastal areas, resulted in the degradation of coastal resources, with long-term economic implications. Both the Provincial and Local Authorities in the Cape agree that existing legislation dealing with coastal towns is inadequate in terms of environmental concerns (Mr R. Barry, Acting Chief Town Planner, Department of Local Government). Furthermore, the present procedure for making application for residential and recre-

ational development along the coast is unsatisfactory. It does not require that an assessment of potential recreational demand and an evaluation of available environmental resources be undertaken.

At the request of various government authorities, several committees have been established and research programmes instituted to investigate and report on problems relating to planning and development along the coast. Some of these investigations are being sponsored by government departments, the CSIR and other bodies.

The following study, funded by the CSIR, addresses the problem of township development in a sensitive coastal zone, by considering the capability of the environmental resources of the area to meet the recreational demands of an increasing holiday population.

1.2 Background to the Investigation

The following history of events that led to this study is based on information gathered from the files of the Infanta Ratepayers Association and Vigilance Committee. (Hereafter the above is referred to as the Infanta Ratepayers Association). These files contain correspondence between the Infanta Ratepayers Association and various government authorities, relating to a proposal to extend the Infanta township.

Towards the end of 1980, certain Infanta property owners

learned that an entrepreneur was planning to make application to develop approximately 100 residential erven on erf 134, which adjoins the Infanta township (see Map 2). A letter dated 8 September 1980 was immediately sent to the Bredasdorp-Swellendam Divisional Council requesting confirmation of this rumoured application and expressing opposition to the proposed development scheme. This matter was raised at the Annual General Meeting held at Infanta during December 1980. Strong opposition to the proposed extension of Infanta was expressed by the majority of the ratepayers.

During 1981 a considerable amount of correspondence circulated between the Infanta Ratepayers Association and various government departments. The Infanta Ratepayers requested that they be informed of any new developments concerning the development of erf 134 and asked for advice on procedure for lodging complaints against a development scheme of this nature. Letters expressing concern and stating objections were sent to the Cape Department of Nature and Environmental Conservation, the Administrator and the Habitat Council.

In a letter dated 6 August 1981, the Department of Local Government sent a reply to Dr Retief (Chairman of the Infanta Ratepayers Association) informing him of the following:

'Met verdere verwysing na u brief ... moet ek u meedeel dat die Uitvoerende Komitee aangedui het dat dit bereid is om 'n formele aansoek om dorpstigting op erf 134 Infanta te oorweeg nadat die aansoek geadverteer was vir besware en alle betrokke staatsdepartemente geraadpleeg was.'

'With further reference to your letter ... I must inform you that the Executive Committee has indicated that it is prepared to consider a formal application for township development on erf 134 at Infanta after the application has been advertised for objections and all relevant government departments have been consulted.'

In response to this, a memoranda dated 2 September 1981, was circulated to all Infanta property owners informing them that a notice calling for objections would soon appear in the Government Gazette and in local newspapers in the Infanta area. Erf owners who objected to the proposed development were urged to submit their written objections either to the Department of Local Government, or to the Chairman of the Infanta Ratepayers Association.

Shortly thereafter, approximately 40 letters of objection were received by the secretary of the Ratepayers Association. The number sent directly to the Department of Local Government is not known as these files are confidential. The principal objections to the proposed extension of the Infanta township have been extracted from these letters and are listed below. (These objections are not listed in order of priority.)

1. Recreational facilities are inadequate to cope with present population pressure during peak holiday

periods.

2. The beach is small and the swimming area limited.

3. Boating and swimming share the same area. This constitutes a danger to bathers.

4. Fishing from the rocky shore is limited and has deteriorated.

5. Many bait organisms and shellfish are already over-exploited. Increased population numbers would accelerate the decline of these resources.

6. Changing the undeveloped coastal township atmosphere by introducing and erecting additional recreational amenities is undesirable.

7. An additional holiday population would spoil the quiet simplicity of the area.

8. There are many plots and adequate recreational facilities on the northern bank of the estuary at Witsands. There is no reason to extend the southern bank to the same extent.

9. The holiday population would more than double in size. Congestion and overcrowding would occur in peak seasons.

10. Cleaning fish on the beach or in small rock pools used by children is undesirable. This would be aggravated by additional holidaymakers.

11. An increased holiday population might encourage entrepreneurs to introduce facilities such as shops,

a petrol station or even an hotel.

12. An increase in the numbers visiting the caravan park poses a threat to the security of the township.

13. Certain itinerant recreationists visiting the caravan park could have little regard for the ecology of the estuary, the veld and coastline.

14. Approval of further residential erven may result in water being supplied to Infanta. Property owners with boreholes and rain tanks would have to pay higher rates and taxes.

15. The present system of garbage disposal is unsatisfactory and constitutes a health hazard. An increase in population would exacerbate this problem.

16. Bird life on the estuary would be further disturbed if the holiday population increased.

In addition to these written representations, a petition dated 4 November 1981, was signed by 56 Infanta erf owners and sent to the Department of Local Government as well as to the Bredasdorp-Swellendam Divisional Council. These objections which were submitted between September and December 1981, were somewhat premature as the developer had not made formal application to the Department of Local Government at this stage.

On 5 November 1981, Local Government sent a further letter

to the Chairman of the Infanta Ratepayers Association:

'Met verwysing na u brief van 19 Oktober 1981 moet ek u meedeel dat die Uitvoerende Komitee bloot aangedui het dat dit prima facie voorkom asof dat behoefte en wenslikheid bestaan vir die stigting van 'n dorp bestaande uit ongeveer 100 erwe op erf 134 Infanta op voorwaarde dat 'n getyswembad van 10 000m² voorsien word. Daar word ook van die applikant verwag om 'n formele dorpsaansoek in te dien voor 4 Augustus 1982. Daar word vertrou dat die posisie nou vir u duidelik is.'

'With reference to your letter dated 19 October 1981 I must inform you that the Executive Committee has clearly indicated that it appears prima facie that a need and desirability exists for the establishment of a township consisting of approximately 100 erven on erf 134 at Infanta on condition that a tidal pool of 10 000m² is provided. It is also expected of the applicant to make formal application for township development before 4 August 1982. We trust that the position is now quite clear to you.'

By the beginning of August 1982, no notice advertising the extension of Infanta had appeared in the relevant public newspapers. As a precautionary measure, the Executive Committee of the Infanta Ratepayers Association sent a letter on 3 August 1982 to Local Government, listing their objections to the proposed development.

No formal application to develop erf 134 was submitted to the Department of Local Government or the Bredasdorp-Swellendam Divisional Council by 4 August 1982. Thereafter, there was no further correspondence relating to this development proposal.

However, at the Annual General Meeting held at Infanta in

December 1982, the point was made that with increasing demand for coastal plots along the southern Cape coast, development proposals of this kind were inevitable in the future. The ratepayers expressed concern about the possibility of undesirable development being approved in the Infanta area without adequate consideration of the environmental consequences of such actions. The view that public feeling towards a development proposal must be considered by the decision-making authorities was strongly voiced. In a paper recently delivered at a conference on Engineering Planning in the Coastal Zone, Beaumont (1984), recognized the inadequate situation with regard to public participation in the planning and development process and made the following point:

> 'Responsible and well managed public pressure groups can provide valuable guidance for decision-makers in terms of local attitudes and values to planning and development proposals.'

1.3 Rationale and Objectives

In response to the overwhelming opposition aroused by the proposal to extend the Infanta township, it was initially decided to undertake an Environmental Impact Analysis (hereafter referred to as EIA) of the proposed development project.

> 'An EIA is a study of the probable changes in various socio-economic and bio-physical characteristics of the environment which may result from a proposed or impending action' (Jain, Urban and Stacey, 1977, p. 3).

In order to accomplish the analysis, considerable knowledge of both the proposed development activities and the environment likely to be affected is necessary.

Most EIA techniques employed in studies in South Africa at present are concerned with identifying primary or first order impacts.

> 'Any effect in the bio-physical and socio-economic environments that arises from a cause directly related to the project is termed a first order or primary impact' (Fuggle, 1983, p. 488).

However, it is well recognized by scholars of EIA that the induced consequences of such actions are often of greater significance because of their long-term and far-reaching environmental consequences. Clark (1977, p. 462) points out that:

> 'the environmental review of residential development applications in coastal areas must include a full range of commercial, recreational and other types of development induced by increased occupancy.'

At the Infanta study site, the proposal to develop 100 additional erven on erf 134, would more than double the existing population during peak holiday periods. This implies greater human pressure on the environmental resources of the area. An important consideration facing the decision-making authorities on receipt of an application to establish or extend a coastal town, is whether the environmental resources and man-made amenities of the area can accommodate the increased holiday population associa-

ted with the proposed development.

A preliminary report giving suggestions of how erf 134 could be developed was prepared, for the developer, by a consulting urban and regional town planner (Moss, 1982). However, since no formal application had been submitted to Local Government by the time the study commenced, and since the developer, when interviewed in December 1983, would not disclose whether he still intended developing the site or not, it was not possible to undertake an EIA.

It was therefore decided to investigate the current human pressure imposed on the Infanta coastal and estuarine environment during peak holiday periods. This would enable projections of the potential recreational demand anticipated at the proposed higher level of development to be made. This is necessary in order to assess whether the environmental resources of the area can meet the demands of the projected increased holiday population.

This project attempts to evaluate the capability of the Infanta environment to cater for an increasing holiday population by assessing the physical, ecological and social carrying capacity of the area. More specifically, the objectives of this study are:

1. to determine the current human pressure on the Infanta coastal environment on the basis of present patterns and levels of recreational use during peak holiday periods;

2. to make projections of future human pressure on this coastal zone associated with the development of 100 additional residential erven;

3. to examine the concept of recreational carrying capacity for this area in order to assess constraints on future development;

4. to indicate in broad terms at what levels of use the recreational carrying capacity of the area will be exceeded for different recreational activities;

5. to elucidate constraints associated with further recreational development in the area;

6. to provide information on human activities to complement the biological studies recently conducted on the Breede River estuary;

7. to provide information which could aid planners and decision-makers to regulate development in this sensitive coastal and estuarine environment.

Throughout the study, the terms coastal zone and estuaries are constantly used. Therefore, it is considered imperative at the outset to define the terms 'coastal zone' and 'estuary' as employed in this study. The coastal zone is

> 'a system with open boundaries which may include estuaries, onshore areas and offshore areas whenever they form an integral part of the system under investigation' (Swart, 1983, p. 1).

> 'An estuary is that portion of a river system which has, or can have, contact with the sea and where at such times, there is within the confines of the land a transition in physical, chemical and biological characteristics from fresh water to seawater' (Heydorn, 1983, p. 8).

1.4 Limitations to the Study

This study is primarily concerned with the capacity of the environmental resources at Infanta, on the south bank of the Breede River estuary, to meet the demands of an increasing holiday population. However, the pressures imposed by recreational activities on the estuarine and marine resources by people holidaying along the north bank of the estuary at Witsands and Port Beaufort (hereafter collectively referred to as Witsands), cannot be ignored.

According to figures received from the Langeberg Divisional council, there were, by the end of 1983, a total of 405 residential erven at Witsands of which 192 were developed. These are mostly used for holiday and retirement homes. Other holiday accommodation offered at Witsands includes an hotel, holiday chalets, a caravan park and camp site.

This outline of available accommodation indicates that the influx of holidaymakers to the Witsands area during peak holiday periods is considerably higher than on the southern bank. The recreational activities of these holidaymakers are thus also imposing considerable pressure on the estuarine environment and marine resources relevant to the study area. In order to assess adequately the recreational

carrying capacity of this region for various water-based recreation activities, a consideration of the patterns and levels of use by Witsands recreationists should ideally have been included. However, these questions were largely beyond the scope of this study and it was therefore not practicable to incorporate such questions.

This represents a limitation to this study. However, in an assessment of water-based recreation activities (see Chapter 6), the reader is reminded that the estimates of human pressure on the environmental resources by the Infanta population alone, is probably a conservative estimate of total human pressure imposed on the system.

It is hoped that a similar study will be undertaken at Witsands over the New Year and Easter holiday season in 1985. Findings from this study will provide the information required to make a more accurate assessment of the capacity of the estuarine and marine resources to cater for the increasing holiday population anticipated at both Witsands and Infanta in the future.

CHAPTER 2 : METHODS

Data for the study were collected from the following sources:

1. a literature review,
2. questionnaires,
3. direct observations,
4. interviews,
5. aerial photographs, and
6. specific scientific investigations.

2.1 Literature Review

A review of the literature relating to (1) the study area, (2) methods employed, (3) concepts used and, (4) topics pertinent to the study, was undertaken. A wide range of references was reviewed as indicated in the reference list at the end of the text.

2.2 Questionnaires

The questionnaire was designed following established techniques documented in Oppenheim (1966) and Babbie (1973). The purpose of the questionnaire was to elicit information from users of the Infanta coastal and estuarine environment concerning:

1. seasonal population influx;
2. quantitative information on recreational activities pursued;

3. recreational activity preferences;
4. reasons for holidaying along the Infanta coast;
5. attitudes towards development in the area; and
6. socio-economic characteristics of recreationists.

The questionnaire was printed in both official languages and distributed to all property owners at Infanta and visitors to the caravan park during the Christmas holiday season in 1983. A copy of the questionnaire distributed in the Infanta village appears in Appendix 1. It was necessary to make slight changes to the questionnaire distributed at the caravan park. These modifications appear in Appendix 2.

Questionnaires were distributed to property owners along the south bank of the Breede River estuary between Kabeljoubank and the Bar Harbour over the Easter weekend, April 1984. (See Map 1, for the boundaries of the study area and the sites where questionnaires were distributed.) The reason for distributing these questionnaires over Easter was that from interviews held with various property owners over the Christmas holiday period, it became apparent that the erf owners along the estuary considered themselves to be a separate group from the Infanta community. It was therefore necessary to modify the title and the introduction of the questionnaire, as well as modify the wording of certain questions. For example, the title of the questionnaire, SURVEY AMONGST HOLIDAYMAKERS AT INFANTA was changed to SURVEY AMONGST HOLIDAYMAKERS ALONG THE SOUTH BANK OF THE

BREEDE RIVER ESTUARY. (See Appendix 3 for these modifications.)

There are various approaches a researcher can employ when administering questionnaires. The self-administered questionnaire which is usually presented by and completed in the presence of the researcher, is considered the most satisfactory method because of the following advantages:

> 'It ensures a high response rate, accurate sampling, and a minimum of interviewer bias, while permitting interviewer assessments, providing necessary explanations (but not the interpretation of questions), and giving the benefit of a degree of personal contact' (Oppenheim, 1966, p. 36).

Mail questionnaires on the other hand, although the cheapest and easiest to administer, usually produce very poor response rates (Oppenheim, 1966, p. 34).

A variation of the self-administered questionnaire, the drop and collect method, was considered the most appropriate for this study. According to Babbie (1973, p. 159),

> 'the appearance of a research worker either delivering the questionnaire, picking it up, or both, seems to produce a higher completion rate than is normally true for straight forward mail surveys.'

Although personal delivery of questionnaires could introduce a certain amount of interviewer bias, the researcher can explain the purpose of the study to the respondent and convey the importance of completing it.

Respondents in the study area who had not completed the

questionnaire on the day of collection, were asked to post them to the researcher in the stamped envelope provided, as soon as possible. Approximately three weeks after the date of collection, reminders were sent to all erf owners who had not yet returned a questionnaire. Addresses of erf owners were obtained from the Bredasdorp-Swellendam Divisional Council. It was not possible to send reminders to visitors to the caravan park who had not returned their questionnaires.

A total of 99 questionnaires were distributed and 77 were returned. This represents a response rate of 77,78% which is considered very good for a survey of this nature. A breakdown of response rates from each sampling area is presented below.

Table 1 : Questionnaire Response Rates

	No. distributed	No. returned	% returned
Infanta	65	53	81,54
Breede River estuary	21	15	71,43
Caravan park	13	9	69,23

Analysis of the questionnaires revealed that two questions relevant to the assessment of recreational activities pursued in the study area, (refer Chapter 6), had been omitted in the questionnaire design. These are discussed in Chapter 6.

2.3 Direct Observations

Direct observations of recreational activities pursued in the study area were made twice daily during the two peak holiday seasons within the study period, namely; from 28 December 1983 to 5 January 1984 and over the Easter weekend in April 1984. An example of the data sheet used to record daily observations appears in Appendix 4.

Along the Infanta coast observations were made from the slipway in front of Infanta each morning at 11h00, using a pair of binoculars. From this vantage point it was possible to scan the entire bay, beach and rocky shore area.

Along the estuary, observations were made from the prawn beds (see Map 2). From here, by walking a short distance up and down the beach, it was possible to observe water-based recreational activities in the estuary and shore-based recreational activities in the area between Kabeljou-bank and the Bar Harbour. These observations were made at 15h00 daily. All recreational activities, as well as the number of people engaged in each activity, were recorded.

Choosing set times to make daily observations is a practical and systematic method of collecting information. However, many recreational activities such as board-sailing depend on weather conditions, while others such as bait collecting, depend on the state of the tide. These

recordings only indicate which activities are most frequently pursued at those times and which recreation sites are most popular.

2.4 Interviews

In depth discussions were held with personnel from the Bredasdorp-Swellendam Divisional Council and planners from the Department of Local Government on matters relating to:

1. the procedure for making an application to develop a township or resort along the Cape coast;
2. criteria employed by decision-makers when assessing the desirability of such an application;
3. the provision of services and recreational facilities at a coastal resort; and
4. environmental problems associated with coastal township development.

At these interviews information on the dates of establishment and rates of growth for both Infanta and Infanta Extension One, were requested. The Department of Local Government was able to furnish the relevant statistics on growth rates from 1968 onwards. However, despite several requests to the Bredasdorp-Swellendam Divisional Council for information on the total number of erven, and the number built on, for each year subsequent to the establishment of these townships, these statistics were not made available.

The proponent of the development of erf 134 was interviewed in December 1983, at the commencement of the study. The purpose of this interview was to ascertain whether he still intended developing 100 residential erven on erf 134, and what services and facilities he would provide should the township application be approved.

The developer did not indicate clearly whether he intended proceeding with the proposed development or not.

2.5 Aerial Photographs

All available air photographs of the study site were obtained from the Directorate of Surveys and Mapping, Department of Public Works and Land Affairs, Cape Town.

Since the photographs ranged in scale from approximately 1:30 000 in 1981, 1:50 000 in 1974, 1:40 000 in 1967, 1:30 000 in 1954 and 1:32 000 in 1942, these had to be brought to a common scale for comparative analysis. In order to achieve this, a Topcon Mirror stereoscope was used to map selected variables from each pair of black and white air photographs onto clear tracing paper. These were photographically adjusted to the scale of 1:30 000 which corresponds to the scale of the earliest (1942) and most recent (1981) air photographs. The air photograph taken in 1942 forms the baseline data against which subsequent changes to the environment were measured.

The following variables were selected for comparative ana-

lysis: roads; tracks and paths (distinguished from roads on the basis of width); indigenous vegetation; alien vegetation; aquatic macrophyte beds (Zostera capensis); proclaimed towns; the caravan park and refuse dump. Changes in length of roads, paths and tracks as well as changes in area of other variables were measured using a computerized Digitizer from the Durvey Department, University of Cape Town.

Two property owners considered to be familiar with the nature of the past environment were consulted in order to clarify interpretation of certain variables. Alien vegetation was one such variable. According to Brownlie (1982, p. 17), a cluster of Acacias can be differentiated from indigenous vegetation as the mature alien Acacias are darker and stereoscopically taller. However, Marrao (1982, in Brownlie, 1982, p. 17) concludes that differentiation between alien Acacia species and low indigenous bushes in black and white air photographs is extremely inefficient. For this reason it was considered necessary to check with these property owners that the alien vegetation mapped using the stereoscope, corresponded to the extent of alien encroachment in the past environment.

A ground check of the most recent air photograph (1981) confirmed that the extent of alien vegetation mapped using the stereoscope was fairly accurate.

2.6 Specific Scientific Investigations

The specific scientific investigations conducted during the course of this study will only be briefly outlined as the method employed for each investigation is discussed where applicable in the text.

1. Fish catch record cards and bait collection record cards were distributed to all sport anglers in the study area over the Easter weekend, April 1984. (See Appendix 5 for a copy of these cards.)

2. A list of fish species known to occur in the Infanta coastal and estuarine waters was circulated to eight sport anglers considered to be knowledgeable about the fish fauna of the study area, for comments.

3. A comparative study of the size frequency distribution of the edible shellfish, Alikreukel, Turbo sarmaticus, collected from an exploited site in front of the Infanta village and at a protected site at Noetsie (see Map 6), was undertaken.

4. Density studies of the mudprawn, Upogebia africana, were undertaken in the vicinity of the Zostera beds in front of Kontiki and compared with similar studies conducted in 1978.

CHAPTER 3 : THE STUDY AREA

3.1 Introduction

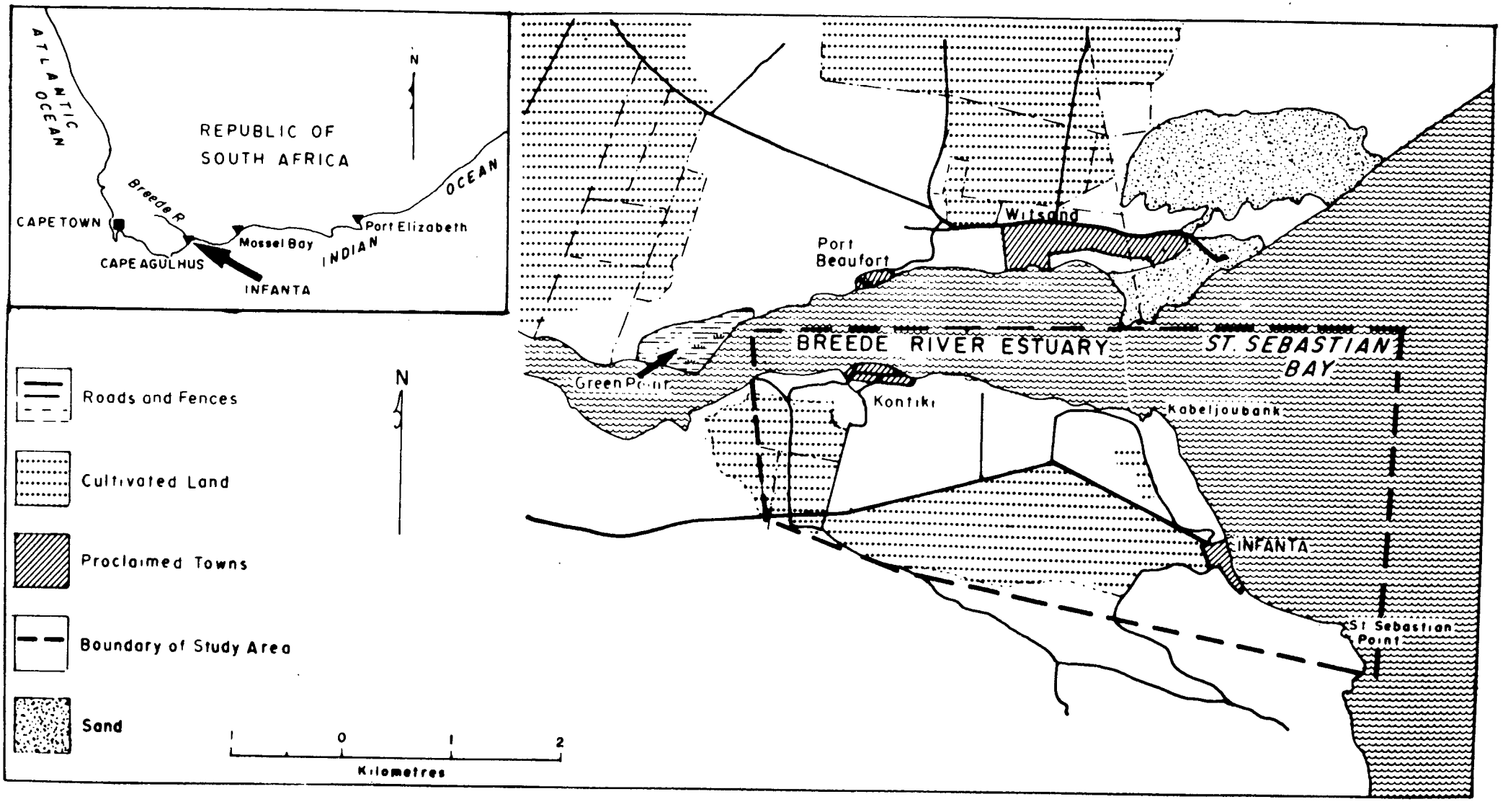
The Infanta study site is situated at 21°50' East and 34°24' South, approximately half-way between Cape Agulhus and Mossel Bay. The location and boundaries of the study area are indicated on Map 1. These boundaries were chosen to include the major recreation sites used by visitors to the Infanta coastal area. (See Map 2 for these details.)

A synthesis of available information on the Breede River estuary has recently been published (Carter, 1983). Therefore, only a brief outline of physical and biological characteristics pertinent to this study, will be given in this chapter. The reader is referred to Carter (1983) for further details on specific environmental components. The socio-economic environment is discussed in greater detail in this report.

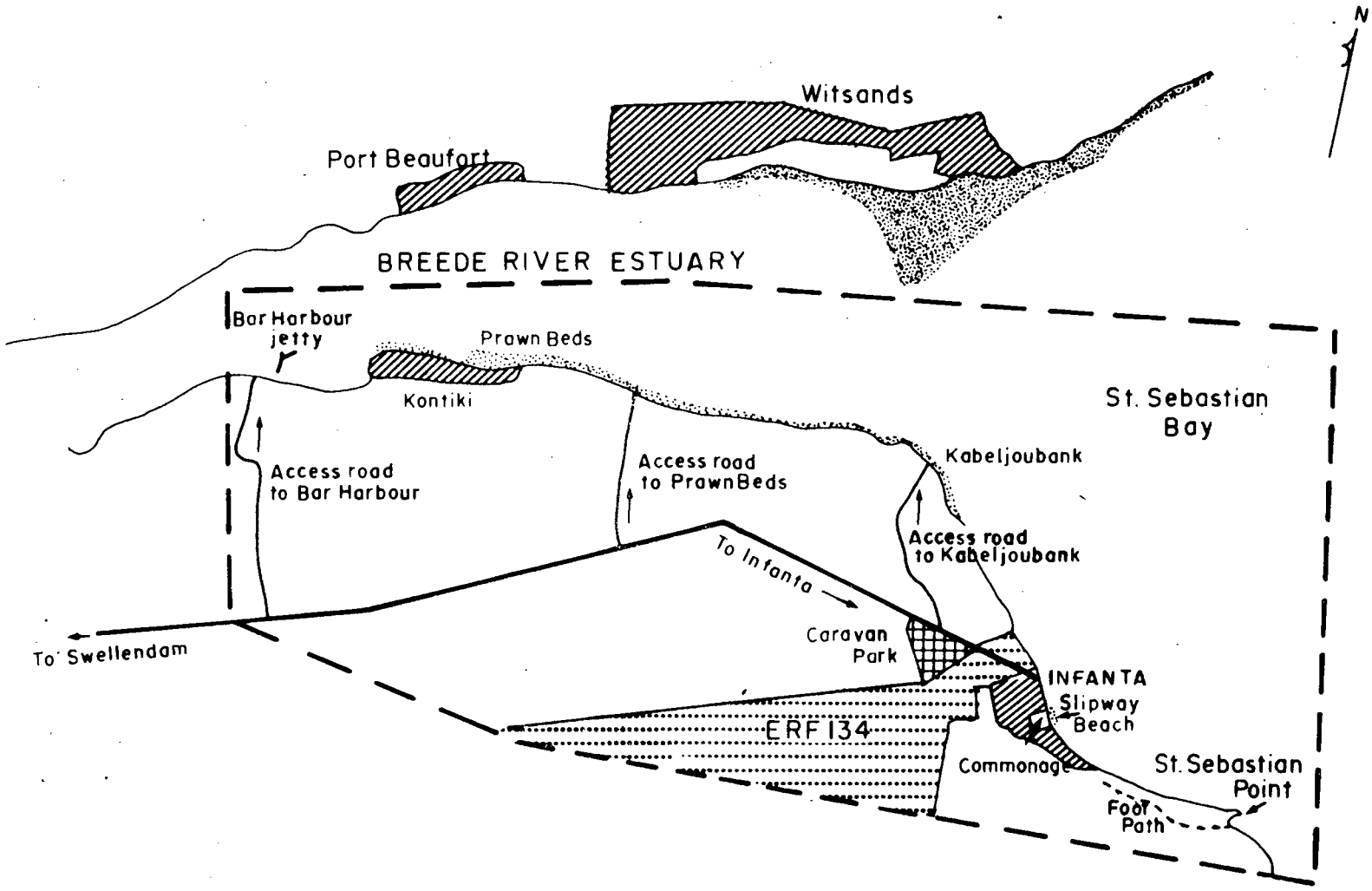
3.2 The Physical and Biological Environment

The Breede River, which is the second largest river in the southern Cape, rises in the mountainous region in the vicinity of Ceres. The catchment of the river is 12 625km^2 with an estimated mean annual run-off of 1 893 x 10^6 m^3 (Noble and Hemens, 1978 in Carter, 1983, p. 3). The river flows strongly in winter, but during the summer months, the flow is considerably reduced. The

MAP I LOCATION MAP



MAP 2 PRINCIPAL LOCALITIES CITED IN THIS STUDY



gradient over the coastal plain is gentle and the river banks are steep so that the tidal influence penetrates as far as 50km upstream (Day, 1981, p. 309).

The single sand spit estuary is approximately 1,5km wide at the mouth and is permanently open to the sea. The main channel has been scoured out along the southern bank of the estuary. Off this south bank are extensive shallow areas, and at low tide, sand banks are exposed.

> 'The mouth itself is against the southern bank which is a wave cut terrace of Bokkeveld shales' (Carter, 1983, p. 7).

From the mouth westwards to St Sebastian Point, the rocky coast comprises irregular, deformed rocks of the Bokkeveld Group.

A vegetation map of the study area has been compiled since the vegetation categories recognized from field surveys and aerial photograph interpretation during the course of this study differed from those identified by O'Callaghan (1983, in Carter, 1983). A geologist currently mapping the geology of the area, was consulted in order to clarify certain geological features and probable vegetation boundaries in the study area.

The following major vegetation categories have been recognized in the study area:

Mountain Fynbos

Coastal Renosterveld

Fynbos on Limestone and calcareous sands, and

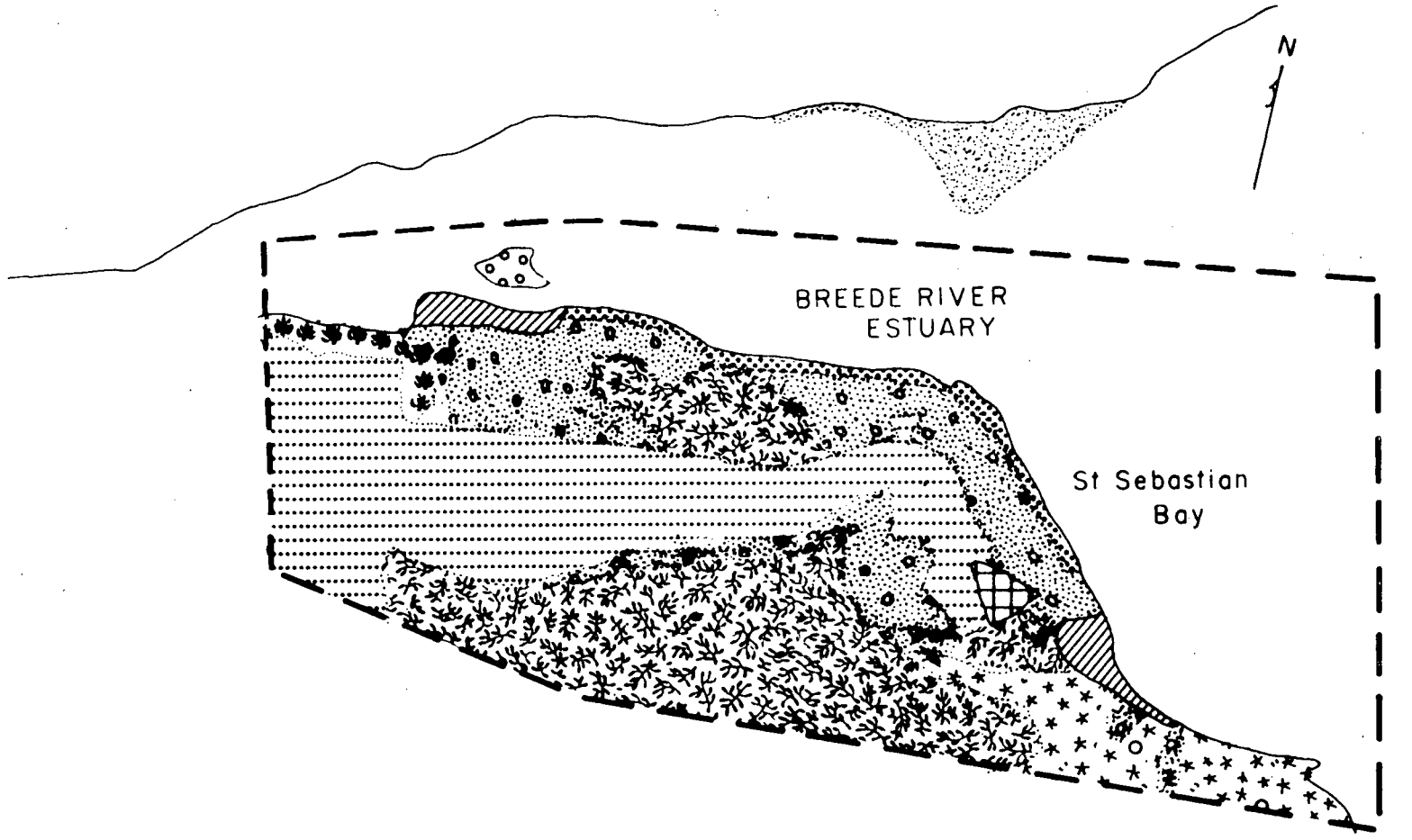
South Coast Standveld (see Map 3).

Mountain Fynbos occurs on sandstones and quartzites of the Table Mountain Series. The primary fynbos elements in this vegetation type are restioid, ericoid and proteoid species.

Coastal Renosterveld occurs on the soils, including clays, clay gravels and ferricretes, derived from the Bokkeveld shales. This veld type is characterized by the presence of renosterbos, Elytropappus rhinocerotis, and usually embraces a selection of aloes. Aloe ferox and Aloe glauca are well represented in this vegetation category in the study area. However, within the study area, Renosterveld has to a large extent been replaced by cultivated lands and invasive alien Acacias.

Fynbos on limestone and calcareous sands has also been recognized in the study area. In the vicinity of the mouth, on the consolidated dunes, limestone outcrops occur and in places the limestone forms a pavement with surface solution hollows. Protea obtusifolia and Leucadendron meridianum, both limestone endemics, are abundant in this veld type. Scattered patches of South Coast Strandveld occur in the dune areas along the coastal margin from east of the Infanta village to the vicinity of the Prawn Beds.

MAP 3 VEGETATION CATEGORIES IN THE INFANTA STUDY AREA



- Coastal Renosterveld
- Mountain Fynbos
- Fynbos on Limestone and Calcereous sands
- South Coast Strandveld
- Dense Alien Vegetation
- Zostera capensis Beds
- Cultivated Land
- Caravan Park
- Proclaimed Towns
- Boundary of Study Area

0 1 2
Kilometres

In general, except for the hills to the west of Infanta, the study area has been invaded by alien species (chiefly rooikrans, Acacia cyclops, and to a lesser extent, Port Jackson, Acacia saligna). A fire which swept through the study area in 1982 has promoted the growth of many Acacia seedlings and will, no doubt, aggravate the alien encroachment process. Large stands of alien vegetation as well as cultivated lands make it difficult to identify the exact boundaries between the vegetation categories from aerial photograph interpretation. For this reason boundaries are represented by dotted lines on the vegetation map.

The aquatic and semi-aquatic vegetation in the Breede River estuary is not well developed. The extent of the macrophyte (Zostera capensis) beds and saltmarsh vegetation in the study area is small and Day (1981, p. 310) attributes this to the steepness of the banks.

The benthic macrofauna of the estuary is fairly rich especially in the vicinity of the Zostera beds. Important bait organisms such as the mud prawn, Upogebia africana and bloodworm, Arenicola loveni, are fairly abundant in the sandy mud substratum associated with the Zostera beds.

There is no published information relating specifically to the rocky shore communities found within the study area. However, the typical south coast rocky shore zonation patterns were recognized along this coast. Various

edible shellfish species such as perlemoen, Haliotis midae; brown mussels, Perna perna; Alikreukel, Turbo sarmaticus and oysters, Crassostrea margaritacea, are present, although numbers seem to be declining (see Chapter 6). Fishermen report that dense colonies of red-bait, Pyuru stolonifera occur in scattered patches in the infratidal zone.

Several surveys of the fish fauna of the Breede River estuary have been undertaken and approximately 47 species of fish have been identified (Carter, 1983, p. 28). The main estuarine fishes, as well as species occuring in the coastal waters off Infanta are listed in Chapter 6. The fish fauna and major bait organisms exploited in the study area are discussed in greater detail in Chapter 6.

The avifauna of the study area has not been investigated in any detail. To date, 177 species of birds have been recorded in the estuary and immediate vicinity (Carter, 1983, p. 30). The Zostera beds and saltmarsh vegetation provides rich feeding grounds for waders. Research work has indicated that the estuary is an important resting and feeding ground for migratory waterbirds (Carter, 1983, p. 30).

3.3 The Socio-Economic Environment

There are two proclaimed towns within the study area, namely; Infanta and Infanta Extension One. Infanta was established in 1929 and comprises 101 erven of which 73 are currently developed. The majority of these are used

for holiday homes. Records of Infanta erf owners obtained from the Bredasdorp-Swellendam Divisional Council indicate that most of the undeveloped erven are owned by people who already have a holiday home in the town. With the growth of family numbers it is anticipated that these second properties will be passed on to the children of existing owners so that they too can own a home in the traditional family holiday area.

Infanta Extension One, also known as Kontiki, is situated on the south bank of the Breede River estuary, approximately 2km upstream from the river mouth. This extension of 16 erven was approved in 1953 and is at present 81% developed. Here, 13 holiday cottages nestle unobtrusively against the hillside and provide a tranquil and scenic setting for a holiday retreat.

Between these two nodes of development there are nine properties, each of approximately 20-30 hectares in area, most of which have been developed and are used for holiday homes.

The only recreational accommodation offered to the public is at a privately-owned caravan park which is situated approximately 1km inland from the beach on a fairly exposed site. Here, rooikrans, Acacia cyclops, has been planted to provide shelter from the south easterly winds which blow during the summer months. Although the park is approximately 4,5 hectares in extent, it does not have adequate facilities and is therefore only approximately 40% occupied during peak holiday periods. Estimates of the numbers of

people that have visited the caravan park over the past five years during peak holiday periods were obtained from the caretaker. These figures are presented in Table 2.

Table 2 : Estimates of visitors to the caravan park over the Easter and Christmas holiday period 1979-1984

Year	No. visitors - Easter	No. visitors - Christmas/New Year
1979	68	72
1980	54	78
1981	70	92
1982	86	98
1983	92	97

All land surrounding the two holiday towns and the caravan park is privately owned. Consequently, focal water-based recreation sites are situated where public roads provide access to the shoreline (see Map 2). The use of private land for recreational activities such as walking and bird-watching is limited, although the first 15 property owners of Infanta have fishing rights on erf 107, which is situated west of the Infanta village (Dr P.J.M. Retief, Chairman, Infanta Ratepayers Association).

The local authority has no servitude property within the study area and consequently refuse is dumped on private land directly behind Infanta (see Map 5). This present system of garbage disposal is most unsatisfactory.

Apart from the beach and rocky shore area, the only public

open space in the study area is the commonage situated in the centre of the Infanta village (see Map 2). Although this area has braai and ablution facilities, it is primarily used by sport anglers for parking their vehicles and boat trailers.

Of historical interest along the Infanta rocky coast are the presence of strandloper middens. These archaeological sites are situated below the commonage in front of the Infanta village and further west beyond St Sebastian Point. Discussions with archaeologists from the South African museum revealed that these sites along the coast have been mapped, but that the area inland has not yet been investigated.

Water is not supplied within this local area. Several property owners have sunk boreholes and struck potable water, but in general, people obtain fresh water from rain tanks. In previous years a shortage of water was a major constraint for further development in the area.

No traditional urban amenities such as cafes, petrol stations or hotels are available within the study area. For many people, this lack of development is one of the major attractions to the area (see Section 3.3.4). Analysis of the questionnaires revealed that, in general, most holidaymakers who visit the area were against the provision of services such as reticulated water supply and other urban amenities. Table 3 summarises the response to the question; 'Which of the following amenities would you like to

have at Infanta?' (see Appendix 1, Question 31).

Table 3 : Visitors attitudes towards amenities in the study area

	In favour of	Neutral	Opposed	Did not answer
Post Office	4	23	44	6
Cafe	8	20	44	5
Small supermarket	11	11	51	4
Hotel	3	7	63	4
Bottle store	1	8	64	4
ESCOM electricity	22	27	27	1
Telephone service	36	23	15	3
Petrol station	20	18	33	6
Reticulated water	12	25	35	5

With the exception of a telephone service, (which is already installed), ESCOM electricity and a petrol station, the provision of amenities was opposed by the majority of respondents.

3.3.1 Visitor profile

A brief outline of particular socio-economic characteristics of questionnaire respondents is presented below. Most questionnaires (71,1%), were completed by males. There were approximately equal numbers of English- and Afrikaans-speaking people holidaying in the study area. The majority of the respondents had professional (52,2%), administrative (20%) or entrepreneurial (15%) occupations. Housewives and retired persons accounted for the remainder of the respondents.

3.3.2 Origin of visitors

The drop and collect survey revealed that 91,3% of property owners and visitors to the Infanta study area come from the South Western Cape. Of these, 48% came from Cape Town and immediate environs, while 23% lived in Swellendam. The remaining holidaymakers came from the Eastern Cape (2,4%), the Transvaal (5,6%) and the Orange Free State (0,7%).

3.3.3 General patterns of use

Analysis of the questionnaires showed that 92,6% of holiday homes were occupied by their owners during the peak holiday seasons. Only five houses had been rented out, and tenants were mostly family or friends of the owner.

All visitors to the study area had visited the area before and only two respondents indicated that they would holiday elsewhere if they had no financial constraints (see Appendix 1, Question 5(a)).

More than half (66,2%) of the respondents visited the Infanta area more than twice a year, 24,7% visited once or twice a year and 7,8% usually visited the area annually. The majority (91,2%) indicated that they often visited Infanta over peak holiday periods, (i.e. the Christmas/New Year holiday season and the Easter weekend). Only 25% of respondents said that they often visited the area during school holidays, while 19,4% visited occasionally. As expected, only very few people visited the area out of

season. As mentioned in Section 3.3.2, many property owners in the study area live in and around Cape Town. As it takes 3-4 hours to drive to Infanta from Cape Town, many find this distance too far for a weekend visit.

From field observations during the Christmas and New Year holiday period, it was evident that the holiday population increased dramatically over the period 24 December to 5 January. Questionnaire results showed that the average length of stay over the Christmas and New Year holiday period was 21 days, the mode being 14 days. Over the Easter weekend most people spent a full four days in the area. When the Easter weekend coincides with the school holidays, many people stay for a longer period. On average, home owners in the Infanta study area annually spend 55 days on holiday there.

3.3.4 Reasons for holidaying along the Infanta coast

Visitors reasons for choosing to holiday along the Infanta coast are listed in order of preference below. This order is approximate as respondents were asked to rate, rather than rank, their preferences. The reader is referred to Question 4 in Appendix 1 for the exact wording of this question.

Table 4 : Reasons for holidaying along the Infanta coast

	EXTREMELY IMPORTANT				NOT AT ALL IMPORTANT	
	5	4	3	2	1	did not rate
'Getting away from it all'	59	5	5	0	3	5
Lack of development	49	12	8	2	3	3
Traditional holiday home	47	3	6	4	13	4
Fishing	46	13	8	2	5	3
Attractive scenery	36	17	12	4	4	4
Inexpensive holiday	35	6	13	3	15	5
Watersports	32	20	11	5	9	0
Boating	28	9	15	5	15	5
Walking/hiking	24	16	14	8	9	6
Sunbathing	22	8	21	7	13	6
Close to home	21	5	8	15	19	9
Birdwatching	12	10	13	8	28	6

Other reasons added to this list by respondents include: whale viewing, archaeological interest, congenial people, crime free area, ecological interest, aloe and cactus gardening and shell collecting. It is of interest that the intangible benefits associated with the holiday experience along the Infanta coast, were considered very important reasons by most respondents when choosing to holiday in the study area. From this preference listing it is clear that fishing is one of the major attractions to the area and definitely the most popular recreational activity pursued.

CHAPTER 4 : HUMAN ACTIVITIES AND ENVIRONMENTAL CHANGE

The previous chapter described aspects of the bio-physical and socio-economic characteristics of the study area. This chapter considers the environmental changes that have occurred in the study area by examining a time sequence of air photographs covering the period 1942-1981. The relationship between the increase in numbers of people utilizing the area since the early 1940's and the extent of environmental change is discussed.

4.1 Introduction

The use of air photographs as a tool for monitoring environmental change is widely recognized. A time sequence of air photographs provides valuable historical information of the environment under consideration since existing environmental characteristics and conditions are 'captured' and recorded 'at different points along a time continuum' (Bayne, 1984, p. 2). Comparison of a series of air photographs enables the interpretor to conceptually reconstruct the nature of the past environment and identify changes that have occurred over the period of air photograph coverage.

> 'The changes in elements of the environment observed through comparative interpretation can be regarded as the 'effects' of previous events' (Bayne, 1984, p. 2).

Thus possible links between 'cause' (activity) and 'effect'

(change) can be made. An understanding of the cause-effect relationship within the system may provide a basis for predicting future changes. In the analysis of possible cause and effect relationships, it must be remembered that the environment is by nature a dynamic system and that natural processes could be the cause of observed changes.

From the outset, it must be recognized that in the comparative analysis of air photographs, various extraneous variables such as the type of film and paper used, the angle and altitude of the aeroplane, weather conditions as well as the state of the tide can distort interpretation. In addition, inaccuracies can arise from the process of photographically adjusting the air photographs to a common scale. Thus despite the existence of sophisticated equipment for quantitative analysis of air photographs, the factors described above make rigorous measurement difficult. Therefore, all measurements of changes in variables selected for this study are presented as approximate measures.

4.2 Variables Selected for Comparative Interpretation

The following variables were selected for comparative interpretation: roads; tracks and paths; indigenous vegetation; alien vegetation; beds of the aquatic macrophyte, *Zostera capensis*; proclaimed towns; the caravan park and the refuse dump. It was felt that changes in area (or length) of

these variables would reflect the increase in development and recreational activities in the area.

Although certain farming practices such as burning veld, bush cutting and fencing constitute major changes to the environment, these were excluded from the analysis since this study is primarily concerned with recreational and development pressure along the coastal zone. However, measurements of the changes in area of cultivated lands from 1942-1981 were taken, since changes in area of indigenous vegetation is inversely related to the extent of the area used for cultivation.

Changes in area of the Zostera beds have also been included in the quantitative analysis, since Carter (1983, p. 12) notes a definite decline in extent of the Zostera beds over time. These macrophyte beds provide a habitat for various estuarine species, including important bait organisms. A reduction in area of the macrophyte beds could affect other components in the estuarine system as well as reduce the bait available for exploitation by recreational fishermen.

4.3 Increase in Human Pressure (1942-1981)

Population growth is probably the best indicator of increasing pressure on the environment available from historical data. For this reason, it was hoped to obtain figures of the number of developed erven in the study area for each year of air photograph coverage. However, as mentioned in Chapter 2, the Bredasdorp-Swellendam Divisional

Council would not provide the researcher with this information. Nevertheless, statistics of numbers of developed residential erven at Infanta and Infanta Extension One for the period 1968-1981, were obtained from the erf registers maintained at the Department of Local Government.

An attempt to elicit information from the aerial photographs for the years 1942-1968 proved unsuccessful, as houses could not be distinguished from other structures such as garages and boat sheds.

Finally, three property owners who have visited the area for the past 40 years were consulted independently. They were asked to estimate the number of developed erven in the study area in 1942 (date of the earliest air photograph) and for each year that air photographs were taken subsequent to this date. All three interviewees estimated that there were approximately ten houses in the early 1940's. However, none of the property owners consulted could remember details of the rate of development in the area and were reluctant to estimate figures for subsequent years. Property owners' estimates of the number of houses and estimates from the erf registers appear in Table 5. The figures given in the erf registers for 1981 are inaccurate since the number of developed erven at Kontiki had been excluded from the total calculation. It is estimated that in 1981 there were approximately 90 holiday homes in the study area.

From these figures, the potential number of holidaymakers

utilizing the area could be estimated by multiplying the number of developed erven by nine since the estimated average number of people per household for coastal townships is given as nine in the Cape Coastal Survey (1973, pg. 47). The potential population influx into the study area for the years pertinent to the quantitative analysis, is presented in Table 5.

Table 5 : Quantitative analysis of human pressure at Infanta (1942-1981)

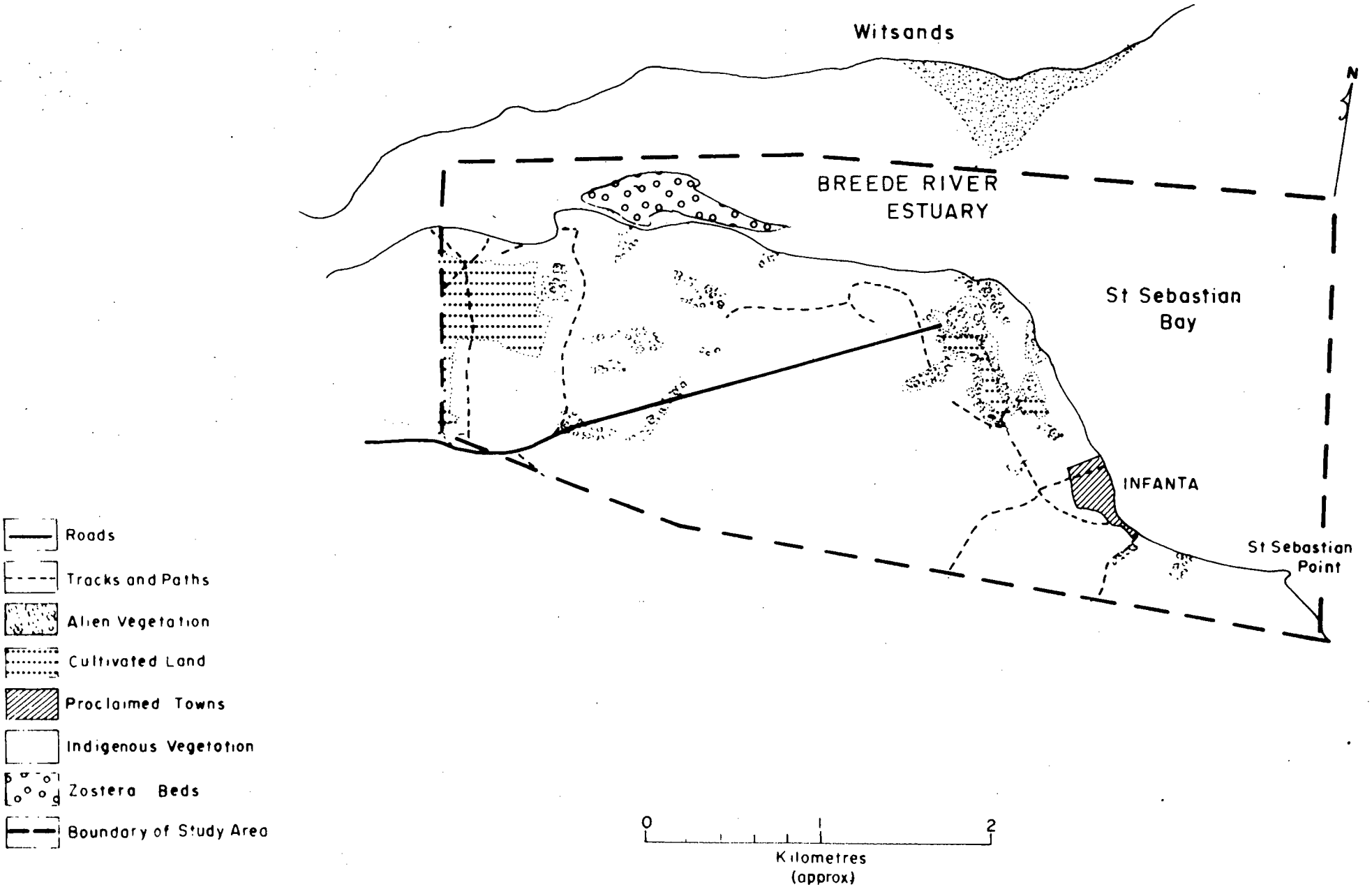
	1942	1954	1967	1974	1981
Approximate No. of houses	10	-	66	73	90
Approximate No. of visitors	90	-	594	657	810

4.4 Interpretation of Aerial Photographs

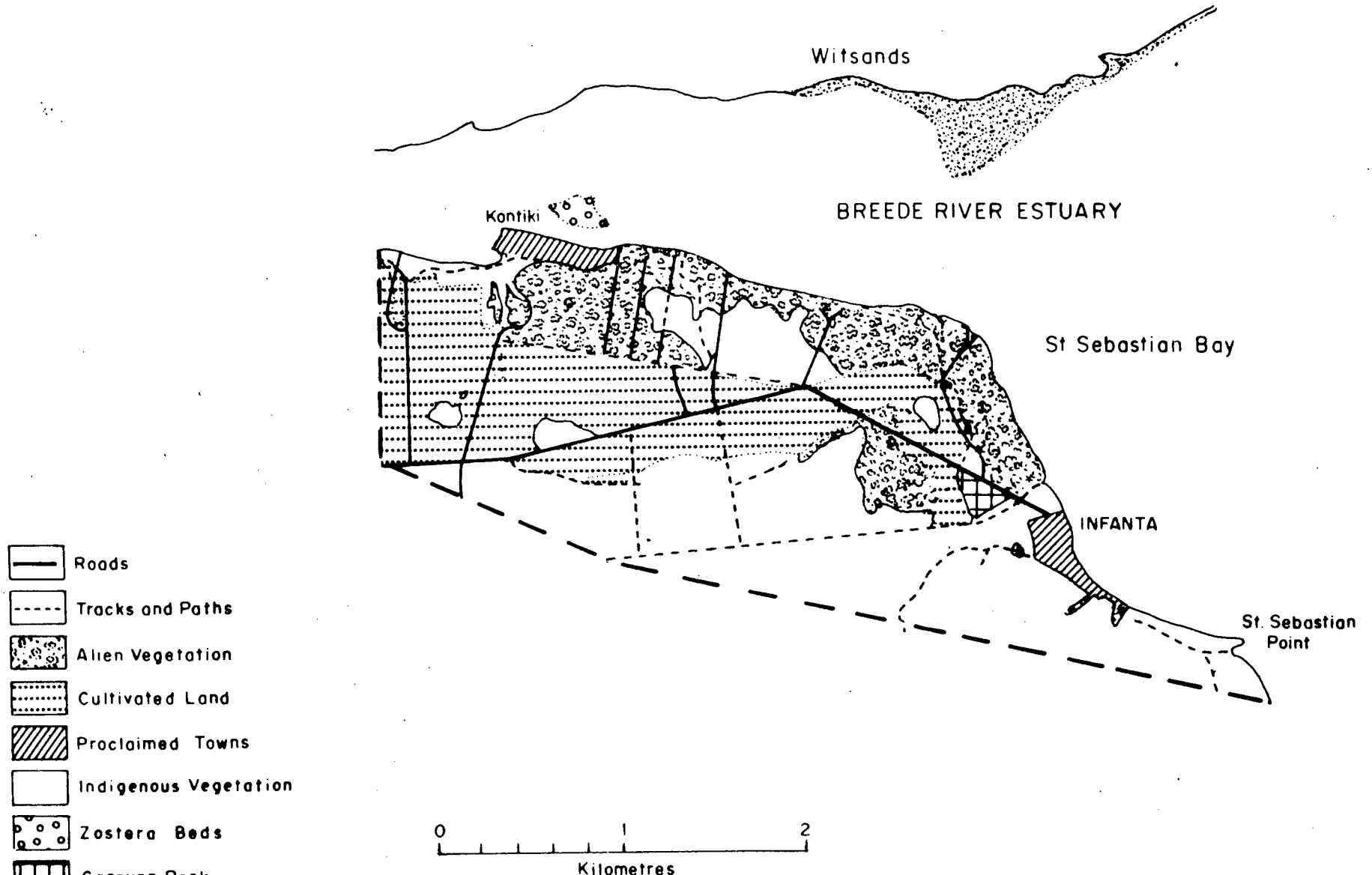
The list of aerial photographs used for this comparative analysis appears in Appendix 6. In order to provide the reader with a spatial and temporal perspective of the environment under consideration and illustrate the major changes that have occurred in the area, maps of relevant features based on the earliest (1942) and most recent (1981) aerial photographs have been included in this chapter (see Map 4 and 5).

The changes in length of roads, tracks and paths are shown in Table 6. Changes in area of other variables are listed in Table 7. The possible causes of the changes are discussed.

MAP 4 ENVIRONMENTAL FEATURES BASED ON 1942 AERIAL PHOTOGRAPHS



MAP 5 ENVIRONMENTAL FEATURES BASED ON 1981 AERIAL PHOTOGRAPHS



4.4.1 Roads, paths and tracks

Roads were distinguished from paths on the basis of width. Table 6 shows an incremental increase in the total length of roads in the study area.

Table 6 : Approximate length of roads, tracks and paths in km in relation to increasing visitor numbers

	1942	1954	1967	1974	1981
Approximate No. of Visitors	90	-	594	657	810
Roads	3,2	4,9	7,9	9,2	9,8
Tracks and paths	2,9	5,4	3,8	7,0	14,8

In 1942, as indicated on Map 4, the only road in the study area was the main access road to Infanta. As more holiday houses were built in the Infanta village and later along the estuary, there is a noticeable increase in the number of roads, tracks and paths in the study area. This is inevitable, since erf owners require access roads to their properties and the public requires access to the recreation sites. The length of tracks and paths decreased in 1967 because tracks that were used more frequently were seen to be wider under the stereoscope and were thereafter considered as roads. In 1942 it is estimated that the population influx during holiday periods was approximately 90. By 1981 this figure had risen to about 810.

4.4.2 Proclaimed towns

The area of Infanta and Infanta Extension One is given in

Table 7. Although the number of houses increased after the establishment of these two towns, the actual area proclaimed for residential development remained constant.

Table 7 : Approximate areas of selected variables within the study area (1942-1981) in relation to increasing visitor numbers

	1942	1954	1967	1974	1981	unit
Approximate No. of visitors	90	-	594	657	810	
Proclaimed townships	7,2	13,7	13,7	13,7	13,7	ha
Caravan park	-	-	-	4,5	4,5	ha
Refuse dump	-	-	200	500	3 500	m^2
Indigenous vegetation	5,2	4,8	3,3	2,7	2,3	km^2
Alien vegetation	0,2	0,6	0,7	0,9	1,2	km^2
Zostera beds	20,5	19,5	10,5	6,1	3,5	ha
Cultivated land	0,4	0,4	2,2	3,5	3,5	km^2

One of the activities associated with residential development is clearing of indigenous vegetation. Disturbance created by construction activities appears to promote the spread of alien vegetation. Map 4 shows that there is already evidence of alien vegetation encroachment in the vicinity of these sites.

4.4.3 The caravan park

The privately-owned caravan park was approved by the Swellendam Divisional Council in the late 1970's. It is approximately 4,5 hectares in extent. Rooikrans, Acacia cyclops, was planted in rows to provide shelter for campers. These trees are clearly visible on the 1981

aerial photographs. The provision of a caravan park is directly related to an increased demand for recreational accommodation along the coast.

4.4.4 The refuse dump

Although refuse has been dumped on privately-owned property behind the Infanta village for the past 20 years, the refuse site is only visible on the aerial photographs in 1967. Map 5 shows the location and extent of the refuse dump. A visit to the site confirmed the extent of disturbance in the area which is visible on air photographs. The increase in area of disturbance at the refuse disposal site is indicated in Table 7.

4.4.5 Vegetation

Map 4 shows the extent of the area covered by indigenous vegetation in 1942. The decrease in area of indigenous vegetation in the study area is one of the most noticeable changes from the comparative analysis of air photographs. A comparison of Maps 4 and 5 illustrates how little indigenous flora remains in the study area. Indigenous vegetation has been cleared for: holiday homes; roads; tracks; the commonage; the caravan park and the cultivation of lands. The invasion of alien Acacias has further contributed to the decline in area of natural vegetation. The increase in area covered by alien species is clearly shown in Table 7.

The increase in numbers of people utilizing the area over

time has led to greater disturbance in the area. The invasive Acacias produce masses of seeds which are widespread in the area today. Consequently any disturbance to soil in this area encourages the germination and spread of these species.

4.4.6 Macrophyte (Zostera) beds

There has been a noticeable decline in the area of the beds of the aquatic macrophyte, Zostera capensis, along the south bank of the estuary (see Maps 4 and 5). A decrease from approximately 20,5 hectares in 1942 to 3,5 hectares in 1981 was measured. A detailed analysis appears in Table 7. Carter (1983, p. 127) attributes the decline in area of Zostera capensis to the redistribution of marine sediments within the estuarine system. However, destructive methods of bait collecting such as pumping (instead of blowing) and removing cores from the sediment can uproot aquatic vegetation and destabilize the substratum. Such practices may have contributed to the decline of these Zostera beds.

4.5 Conclusion

The comparison of a sequence of air photographs covering the period 1942-1981 revealed that major changes have occurred in the environment under consideration. The interpretation of possible links between 'cause' and 'effect' indicates that almost all of the observed changes can confidently be linked to an increase in development

and recreational activity in the study area after the proclamation of Infanta and Infanta Extension One in 1928 and 1953 respectively.

CHAPTER 5 : RECREATIONAL CARRYING CAPACITY

In the previous chapter, the relationship between the increase in numbers of people visiting the study area since 1942, and the amount of environmental change, was investigated. This chapter examines the concept of recreational carrying capacity.

5.1 Introduction

> 'Recreational carrying capacity is a complex and troublesome concept that incorporates principles of the social as well as the physical and biological sciences' (Lime, 1977, p. 122).

The concept of carrying capacity has been addressed by several scholars since the 1940's, but the basic conceptual framework has not changed. In essence, all definitions of recreational carrying capacity incorporate two central aspects, namely; maintaining the integrity of the resource base and providing a recreation experience of high quality to the user. Both these aspects point to the subjective nature of the concept.

Maintaining the integrity of the resource base implies some threshold or tolerance level after which further exploitation or use may exceed the ecosystem's natural homeostatic controls. Determining this tolerance level requires making a subjective value judgement. Equally subjective, is deciding what constitutes a recreation experience of good quality. Undoubtedly an individual's perception of a good quality recreation experience depends on

numerous factors and varies from person to person. Furthermore, a resource manager may interpret the quality of a recreational experience from a completely different set of premises than those used by a user.

A recent and elegant review of the current thinking on recreational carrying capacity has been given by Pigram (1983). His work draws heavily on the concepts of the Countryside Commission (1970) which distinguish four separate categories of carrying capacity. These are: (1) Physical carrying capapcity, (2) Economic carrying capacity, (3) Ecological carrying capacity, and (4) Social carrying capacity.

5.2 Physical Carrying Capacity

Physical carrying capacity is concerned with the maximum number of use units (people, vehicles, boats) which can be physically accommodated in an area. In many ways it is a design concept, as when referring to the capacity of a car-park, a spectator stand, or a theatre (Pigram, 1983, p. 68). Depending on the environment and activities pursued, a consideration of a safety aspect may also be involved. For example, in a limited space when two conflicting recreational activities take place, danger may further restrict carrying capacity. In this situation, segregation of incompatible recreation activities, such as swimming and powerboating would be one way of eliminating the potential danger that could arise when two conflicting

recreational activities take place in the same recreational space. But such segregation would further limit the carrying capacity of the area.

Both Pigram (1983, p. 69) and Little (1984, p. 6) suggest that by restricting the capacity of ancillary facilities such as car parks, trailer parks and boat ramps, or by limiting the number of ski-boats belonging to a club, it is possible to regulate the numbers participating in water-based recreation activities and prevent congestion of the water surface. This strategy may be a useful management tool in areas to which access is controlled and which are specifically managed as recreation sites. However, attempting to restrict recreational facilities in coastal townships where people have purchased property with the intention of utilizing the area's natural resources for their own enjoyment, would not necessarily work. People might continue utilizing the environmental resources of the area, despite overcrowding or potential danger of conflicting activities. Property owners would feel that they had a right to use the area's resources and recreational facilities. The concept of physical carrying capacity is the easiest to grasp and quantify because for many recreation activities the site imposes physical limits.

5.3 Economic Carrying Capacity

The second category, economic carrying capacity, relates to situations where a resource is simultaneously utilized

for outdoor recreation and economic activity, such as a domestic water supply reservoir. Here, the concern is to establish acceptable recreation use levels that do not interfere with the non-recreational activity and possibly reduce the economic viability of the resource.

Since the study area at Infanta does not present this problem an assessment of economic carrying capacity is not relevant.

5.4 Ecological Carrying Capacity

> 'Ecological carrying capacity (sometimes confusedly referred to also as physical, biophysical or environmental capacity) is concerned with the maximum level of recreational use, in terms of numbers and activities, that can be accommodated by an area or an ecosystem before an unacceptable or irreversible decline in ecological values occurs' (Pigram, 1983, p. 69).

The difficulty with this definition is, firstly, deciding what constitutes an unacceptable change or irreversible decline in ecological integrity and, secondly, who should be responsible for making this decision - the public (i.e. the recreation users of an area), the responsible local administrative authority or an ecologist.

In 1971 Lavery recognized that knowledge about the rates and directions of change in ecosystems resulting from the effects of recreational activities was limited. Since then there has been considerably more interest in understanding how recreational acitivties impact upon the

natural environment. But, in general, this research has focused primarily on the effects of walking and hiking on soil and vegetation.

> 'A considerable literature exists on the effects of trampling on soil and vegetation, and there are extensive materials on campground deterioration' (Wall and Wright, 1977, p. 2).

In recent years work has also been done on the effects of off-road vehicles and downhill skiing on the environment.

However, research on the effects of recreational activities on other resources, particularly the effects of water-based recreation activities on coastal and estuarine environments, is limited. In South Africa most recreation pressure is concentrated in the coastal zone. Studies of the response of coastal resources to various types of recreation activities and levels of use are therefore required. Wall and Wright (1977, p. 10) stress that studies are needed to correlate intensity of recreational use with magnitude of environmental deterioration.

There are several problems associated with monitoring environmental change caused by recreation activities. The major problem facing the researcher is controlling the variables under investigation. Components of an ecosystem are constantly being subjected to changing environmental conditions. This leads to the difficulty of defining a base level against which to measure man-induced change. Recreation activity is also variable, since levels and

intensity of recreational use are constantly changing. In addition, Lavery (1971, pp. 266-267) points out that most recreational sites have different spatial boundaries from those of existing ecosystems; this adds to the difficulty of making an integrated functional analysis of the problem.

A further complication is that some ecosystems may react slowly to recreational pressure, and environmental changes may only be manifest at a later stage. Thus it becomes difficult to establish direct cause-effect relationships between recreation activities and ecological degradation. These represent some of the inherent problems associated with obtaining quantitative evidence of the ecological effects of recreation. So although there is an urgent call for more directed research into the effects of recreation activities, especially on water and wildlife resources (Lime and Stankey, 1979, p. 116), it must be recognized that results from research of this nature will not necessarily provide precise measures of ecological carrying capacity which are generally applicable. It will, however, elucidate potential effects of the recreation activity on the resource base, identify areas where uncertainty exists and indicate when and where conservative recreation use levels should be adopted.

Despite attempts to improve understanding of the tolerance of ecosystems to different levels of recreation pressure, in order to arrive at objective estimates of the ecological

carrying capacity of an area or ecosystem, determining what constitutes a decline in ecological value is ultimately a subjective value judgement. Consideration of the attitudes and values of recreationists towards resources therefore constitutes a fundamental component when determining the recreational carrying capacity of an area.

5.5 Social Carrying Capacity

Social carrying capacity (also referred to as perceptual, psychological or behavioural capacity) is concerned with the visitor's perception of the presence (or absence) of others simultaneously utilizing the resources of an area. In essence, this concept is concerned with the effect of crowding on the enjoyment and appreciation of the recreation site or experience. The Countryside Commission (1970a, in Pigram, 1983, p. 71), defines social carrying capacity as:

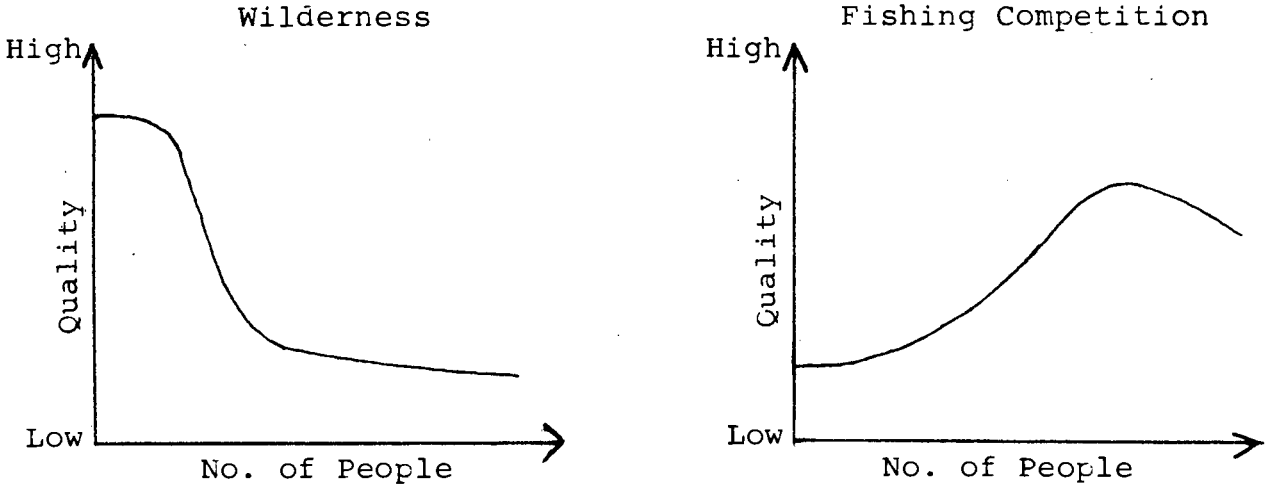
> 'the maximum level of recreational use, in terms of numbers and activities, above which there is a decline in the quality of the recreation experience from the point of view of the recreation participant'.

This is the most abstract of the capacity concepts since the level of crowding tolerated would not only vary between individuals but could also vary for the same person in different situations. Recreationists in search of a wilderness experience are unlikely to appreciate frequent encounters with others. Even evidence of high levels of use may reduce the quality of the wilderness experience.

Research by Lucas (1964, in Lime and Stankey, 1979, p. 110) on attitudes of canoeists to crowding in a wilderness area revealed that they objected to encountering other people, especially if they were in powerboats.

On the other hand, being the sole participant in a fishing competition would probably not constitute an enjoyable recreation experience either. In fact, the satisfaction gained from such a gregarious occasion would increase with the numbers participating in the competition, at least to a point where crowding may begin to reduce the level of enjoyment. An attempt to show the relationship between social carrying capacity and the quality of the recreation experience is illustrated graphically in Figure 1.

FIGURE 1 : The Effect of Crowding on the Quality of the Recreation Experience



The authors of the Cape Coastal Survey (1973) maintain that every person, no matter how gregarious he may be, is conscious of a degree of crowding beyond which he will experience diminishing amounts of satisfaction from participating in a particular activity. This may not be entirely true for all recreational pursuits nor for all people. The degree of crowding on the Durban beachfront during peak summer holiday periods, for example, suggests that there are recreationists who enjoy this bustling, crowded, holiday atmosphere, otherwise they would choose to holiday elsewhere.

At present, the ways in which various levels of use, types of activities, site design, variety of recreation opportunities and diversity of landscape affect the experience of the recreationist, are little understood. What constitutes a satisfying recreational experience of good quality for one user may be entirely undesirable to another. The social aspect of determining carrying capacity is the least tangible concept and consequently the most difficult to measure. Obtaining information on people's attitudes towards various recreation issues constitutes an extremely important element in assessing the recreational carrying capacity of an area. Questionnaires, public surveys and interviews are some of the methods available to the researcher to elicit public opinion.

It may be argued that obtaining public opinion will complicate any attempt to determine recreational carrying

capacity, since a range of attitudes towards a specific issue could exist. A question that arises is whose values or opinions should be considered as being truly representative of prevailing social attitudes. Often the researcher is interested to know the attitudes of a particular group of people towards a specific recreation issue, such as, what hikers regard as an acceptable group size on a wilderness trail, or in the case of this research project, what holidaymakers feel about further township development in the Infanta area.

Surveying public opinion provides valuable insights into people's perception of what constitutes a recreational experience of good quality. This input can greatly assist decision-makers in determining the level of crowding that will be acceptable to the majority of recreationists.

In this review of recreational carrying capacity, most of the discussion has focused on ecological and social aspects. This does not mean that the other categories are of less importance. All aspects are important in determining the recreational carrying capacity of an area but some are more relevant than others depending on the nature of the environment and the types of recreational activities pursued.

CHAPTER 6 : AN ASSESSMENT OF MAJOR RECREATIONAL ACTIVITIES PURSUED IN THE STUDY AREA

In the previous chapter the concept of recreational carrying capacity was examined. In this chapter, current and projected levels of use associated with major recreational activities pursued in the study area are given. The major recreational activities are then assessed in terms of the recreational carrying capacity of the area.

6.1 Introduction

In any analysis of recreational carrying capacity it must be recognized that even extensive research in a particular environment will not explicitly determine the optimum carrying capacity for that area, because:

i) the environment is dynamic and varied,
ii) man, by his very presence, modifies his environment, and
iii) man's attitudes and perceptions are constantly changing.

Nevertheless, an assessment of activities pursued in the study area, in terms of the spatial requirements of the activity, the resilience of the ecosystem to different kinds and levels of use, and the attitudes of the recreationists, will indicate the range of capabilities of the environment for recreation and related human activities and point to

socio-economic, physical and ecological constraints associated with increased development. Furthermore, a detailed analysis of population trends will indicate whether additional resources such as bait farming, or recreation facilities such as a boat ramp, would be required and whether restrictions - such as activity zoning - should be implemented at different levels of development. On the other hand, the analysis may indicate that existing environmental resources and recreation amenities are adequate for projected population numbers during peak holiday periods. Such projections could have important financial implications for both developers and the local authority.

6.2 Current and Projected Human Pressure at Infanta

The current human pressure in the study area during peak holiday periods was obtained from questionnaire analysis and where possible, confirmed by direct observations (refer Chapter 2 on Methods). Statistics on total numbers of people holidaying in the area, numbers participating in different recreation activities as well as the numbers and types of recreational craft used, were obtained. All quantitative information relating to recreational activities, elicited from the questionnaire, is presented in summary form in Table 8.

Although only 74% of the total number of questionnaires distributed were returned, (81,5% from Infanta, 71,4% from Infanta Extension One and 69,2% from the caravan park) it is possible to estimate total human recreational pres-

sure in the study area during peak holiday periods by proportional calculation.

For example, in order to determine the potential number of people present in the study area, the following information was used. From Question 6, (see Appendix 1 for the exact wording of this question) the total number of people per residential site could be ascertained, thus the average number of people per household could be determined. For Infanta and Infanta Extension One, a remarkably similar average number of people per household was obtained; 6,88 and 6,93 respectively. (This result is worth noting since the Cape Coastal Survey (1973) gives the average number of people per holiday home during a peak holiday season as nine.) Since the total number of developed residential erven is known, the potential population for these two townships can be determined by multiplying 6,9 by the number of houses in the study area. To this figure must be added the number of people accommodated in the caravan park. Since the questionnaire response from the caravan park was low, and the numbers of people per group, as indicated by response to question 6, was highly variable, it was decided to obtain estimates of caravan park population numbers from the caretaker's records. These are approximate figures since payment is per site and not per person. Addition of these two sets of figures gives an estimate of the total population that could be expected in the study area during a peak holiday season.

TABLE 8 : A summary of current and projected human pressure in the Infanta coastal and estuarine environment during peak holiday periods

Item	Low or Current Estimate	Probable Estimate	High Estimate
People	893	1 127	1 817
vehicles	310	392	632
sailboards	63	80	129
canoes	52	65	105
surfboards	75	95	153
shellfish divers	80	101	163
spear fishermen	52	65	105
boats	122	154	248
- used at sea	85	107	173
- used on river	97	122	197
ski-boats	83	105	170
- used for fishing at sea	67	84	136
dinghys	25	32	51
rowingboats	7	8	14
rubber inflatables	3	4	7
sailing boats	3	4	7
ski-boat anglers	217	272	441
boat engines	164	206	333

Refer to Appendix 1, for a copy of the questionnaire from which these statistics were derived.

Projections of the growth in recreational activities in the study area have been made. Such projections are crucial since recreation planners need to identify the future volume and range of recreational activities in order to match predicted levels of demand with the supply of recreation opportunities (Lavery, 1971, p. 41). Projection of numbers of recreationists and numbers of recreational craft expected in an area, as well as estimates of numbers of persons participating in the different activities, play a fundamental role in coastal recreation planning and development.

In this study projections of population and recreation trends at three different levels of development have been made.

A low or current estimate of human pressure has been calculated from population numbers expected in the study area during peak holiday periods assuming all currently developed residential erven are occupied by the mean number of persons occupying residential sites (i.e. 6,9 people per household) and that the caravan park is 40% occupied. (Forty percent has been the average occupancy during peak holiday seasons for the past five years.) These statistics are presented in the first column of Table 8.

A probable estimate of human pressure has been calculated from population numbers expected in the study area during peak holiday periods by assuming that all the erven in the study area will be developed and occupied by the present

average of 6,9 individuals per site. It is also assumed that the caravan park may be 100% occupied. (At present Infanta village is 72,3% developed and Infanta Extension One is 77,8% developed.) Column 2 of Table 8 lists these statistics.

A high estimate of human pressure has been calculated in the same manner as for the probable estimate but under the assumption that the proposal to extend the Infanta township, by developing a further 100 erven is approved (refer Chapter 1, Section 1.2). Potentially this development will introduce 690 more people into the study area during peak periods. These figures appear in Column 3 of Table 8.

When assessing the recreational carrying capacity of the study area (Chapter 6), constant reference will be made to these estimates of population pressure - i.e. 'low or current', 'probable' and 'high', and the reader is frequently referred to Table 8 which summarises all the statistical information.

At present, in the Cape Province, a prospective developer is not required to determine the present population influx into an area during a peak holiday period when motivating the need and desirability for establishment or extension of a coastal town. Nor is he required to give an estimate of the potential number of people expected in the area when the proposed development is complete and all accommodation fully occupied. In addition, the applicant is not re-

quired to provide information on either the natural resources or the existing man-made facilities of the area. Without such information it is difficult for decision-making authorities to evaluate whether environmental resources can meet the demands of the increasing holiday population.

The capability of the natural resources and existing man-made facilities of an area to continue to provide for recreational use, at increased population levels, raises the concept of carrying capacity. Thus in an area where residential and recreational development is proposed, an assessment of the recreational carrying capacity of the area should be undertaken.

6.3 Major Recreational Activities Pursued in the Study Area

From questionnaire analysis and direct observations during peak holiday seasons the following emerged as the major recreational activities pursued in the study area, listed in order of popularity:

1. Sport fishing - including bait and shell-fish collecting
2. Watersports
3. Boating
4. Walking/hiking, and
5. Sunbathing

Other activities pursued, but to a far lesser extent, in-

include birdwatching, picnicking, braaing, whale viewing and gardening.

6.3.1 Fishing

6.3.1.1 Introduction

It has been calculated that the annual increase in angling in southern Africa exceeds that of population growth (van der Elst, 1981, p. 21). Approximately 300 000 fishing reels are sold each year in South Africa, which gives some indication of the large numbers of people participating in this recreational activity. According to van der Elst (1981, p. 21) if the quality of fishing is to be maintained in South Africa, three to four times as many fish will have to be available for capture by the year 2000. This is highly unlikely as there is evidence world-wide, of a decline of fish stocks.

It has been estimated that the number of ski-boats used for fishing along the southern Cape coast is 400 (Kapp and Coetzee, 1984, p. 18). Analysis of questionnaires returned from the Infanta study area indicate that there are 83 ski-boat fishermen who regularly launch from the Infanta slipway and fish in St Sebastian Bay. The figure of 400 is therefore probably a very conservative estimate of the actual number of ski-boat anglers fishing along the southern Cape coast.

6.3.1.2 Fishing in the coastal and estuarine waters off Infanta

The Infanta rocky coastline, St Sebastian Bay, and the Breede River estuary provide excellent and diverse angling opportunities.

> 'The Breede River estuary is famous as an angling resort and many record catches of kob, white steenbras, grunter and leervis have been made there' (Day, 1981, p. 310).

Although fishing ranked fourth on the list of reasons for choosing to holiday at Infanta (see Chapter 3, Table 4), it was by far the most popular recreational activity pursued in the study area. Of the questionnaires returned, 76,6% gave fishing a rating value of 4 or 5 - i.e. the important end of the Likert scale (refer Appendix 1, Question 4).

The only suitable ski-boat launching place along the Infanta rocky coastline is the slipway in front of the Infanta township. Very few boats navigate through the Breede River mouth. Of the questionnaires returned only five sport anglers who own property along the estuary indicated that they venture through the treacherous mouth.

6.3.1.3 Fish fauna in the study area

Information on fish species occurring in the Infanta coastal waters has been compiled by Zoutendyk, a marine biologist by profession and a property

owner in the Cape Infanta area. These lists which appear in Carter (1983) and in Hey (1983), indicate the present status of fish stocks and record observations made during the period 1947-1982.

In order to add to the information available on fish occurring in these waters, these lists, without comments, were sent to eight Infanta property owners who have fished in the Infanta waters for the past 40 years for comment. Each respondent was asked to:

1. Add to the list any species caught but not listed, and
2. Delete any species incorrectly listed, stating reasons for deletion
3. Comment on the present status of the species
4. Make any remarks from personal fishing experience relating to size, frequency and distribution of fish in the area (see Appendix 7 for a copy of the letter). Of the eight lists distributed, six were completed and returned. The synthesized information appears in Table 9.

There was a remarkable degree of consensus among respondents with regard to the present status of fish. Species described as declining were compared with the Marine Linefish Programme priority

TABLE 9 : Fish caught in the coastal waters off Infanta

SPECIES	COMMON NAME	STATUS	REMARKS
Amblyrhynchotes honckenii	Evileyed blaasop	common	Undesirable angling fish. Common in shallow, sandy areas.
Argyrosomus hololepidotus	Kob	very common	Mainly caught from boats 1-10kg. Numbers declining. Largest recorded in 1958 - 63kg.
Atractoscion aequidens	Geelbek	rare	Occasionally caught from ski-boats at sea.
Boopsoidea inornata	Fransmadam	abundant	Undesirable angling fish.
Cheimerius nufar	Soldier	very common	Mainly caught from ski-boats in summer in vicinity of Duiwenhoks River mouth. Records of up to 2,2kg taken.
Chirodactylus brachydactylus	Twotone fingerfin	common	Mainly recorded from diving.
Chrysoblephus cristiceps	Dageraad	present	Previously abundant. Numbers declining. Good catches in vicinity of Duiwenhoks River mouth (see Map 6). Usually of good size. Largest recorded 6,3kg.
C. laticeps	Roman	common	Frequently recorded by divers. Big size seldom caught. Average size caught 2,2kg.
Conger wilsoni	Cape conger	present	Seldom caught. Sometimes caught at night when catching elf.
Coracinus capensis	Galjoen	common	Still good catches although numbers have declined.

TABLE 9 : Continued

SPECIES	COMMON NAME	STATUS	REMARKS
Cymataceps nasutus	Poenskop	rare	Occasionally caught from boats - rarely from rocks. Largest recorded in 1962 - 33,6kg.
Diplodus cervinus	Zebra	common	Frequently observed by divers. Often occurs amongst Galjoen. Previously 2,5-3,0kg average size. Size caught decreasing.
D. sargus	Blacktail	very common	Most common fish caught off rocks. Average size caught 1kg.
Epinephelus gauza	Yellowbelly rock-cod	present	Previously abundant. Numbers and size decreasing. Rarely caught off rocks, mainly from boats. Largest recorded 9,1kg.
Gymnocrotaphus curvidens	Janbruin	present	Seldom caught. Fair numbers recorded by divers.
Katsuwonus pelamis	Skipjack	present	Occasionally arrives in large shoals.
Lichia amia	Leervis	present	15kg fish abundant in 1940's. Numbers and size declining. Fairly common in the Breede River estuary.
Lithognathus lithognathus	White steenbras	rare	Seldom caught at sea. Common in the estuary.
Liza richardsoni	Southern mullet	common	Frequently seen in shoals off rocks. Seldom caught.
Merluccius capensis	Stockfish	rare	Individual fish caught amongst kob.
Neoscorpis lithophilus	Stonebream	rare	Only caught from rocks. Largest recorded 1,5kg.

TABLE 9 : Continued

SPECIES	COMMON NAME	STATUS	REMARKS
Odontaspis taurus	Spotted ragged tooth shark	common	Largest recorded 2 700mm long. Frequently seen from boats.
Oplegnathus conwayi	Cape knifejaw	present	Seldom caught. Plenty observed by divers.
Pachymetopon grande	Bronze bream	present	Usually in small shoals in shallows. Average size caught 3kg. Numbers caught declining.
Petrus rupestris	Red steenbras	rare	Previously abundant. Numbers declining. Largest recorded 40,9kg.
Polysteganus undulosus	Seventyfour	very rare	Occasionally caught from boats. Two recorded in 40 years by one regular sport angler.
Pomatomus saltatrix	Elf	common	Good catches from November to May. Excellent catches recorded in 1983 and 1984.
Rhabdosargus globiceps	White stumpnose	present	Mainly caught in the estuary. Juvenile fish plentiful in estuary.
Sarda sarda	Atlantic bonito	rare	Many caught off rocks in 1950's with spinners. Reasonable catches in some years.
Sarpa salpa	Strepie	abundant	Diving observations confirm large numbers. Caught from rocks.
Scomber japonicus	Mackerel	very common	Good catches during summer months.

TABLE 9 : Continued

SPECIES	COMMON NAME	STATUS	REMARKS
Seriola lalandi	Cape yellowtail	present	Previously abundant. Numbers caught declining. Largest recorded 24kg. 60 caught by one boat in January 1984.
Sparodon durbanensis	Musselcracker	present	Occasionally caught off rocks. Numbers declining. Largest recorded 19kg in 1976.
Spondyliosoma emarginatum	Steentjie	rare	Very rarely caught.
Thunnus alalunga	Longfin tuna	rare	Seldom caught off Infanta coast. Few small fish caught from boats in 1970's.
T. albacares	Yellowfin tuna	present	Not recorded every year. Still good catches up to 35kg. Largest recorded 40kg.
Thyrsites atun	Snoek	rare	Caught on rare occasions from boats. Recorded about every five years.
Trachurus capensis	Maasbanker	rare	Occasionally caught from boats. Used mainly for bait.
Umbrina capensis	Baardman	present	Seldom caught with rod. Shoals of 20-30 fish frequently observed by divers. Largest recorded 5kg.

species list (Wallace and van der Elst, 1983). Good agreement was found.

There is more information available on the fish fauna of the Breede River estuary. The findings of various surveys conducted in the estuary have been summarized by Carter (1983). These surveys record 47 fish species from the estuary. This list was also sent to eight fishermen familiar with the estuary for comment. Only five lists were returned. Nevertheless, the comments provide valuable supplementary information on the subject and a synthesis of comments and personal observations appears in Table 10.

Since recreational fishing is one of the major attractions to the area and is a significant reason for buying property in the area, it seemed appropriate to investigate the current human pressure on the fish and bait resources in the study area.

6.3.1.4 Fish catches over the Easter weekend 1984

An attempt to monitor the catches of both shore anglers and ski-boat fishermen was made throughout the 1984 Easter weekend - a peak holiday period - in order to obtain some indication of the occurrence and abundance of fish in the area, and also to determine the catch per unit effort (CPUE) and the total catch of recreational fishermen. Three

TABLE 10 : Fish recorded from the Breede River estuary

SPECIES	COMMON NAME	STATUS	REMARKS
Ambyrhynchotes honckenii	Evileyed blaasop	common	Undesirable angling fish. Common in shallow sandy areas.
Argyrosomus hololepidotus	Kob	common	Common in sea and estuary. Caught mainly at night. Still catch fish up to 50kg.
Atractoscion aequidens	Geelbek	very rare	Very rarely caught in the estuary.
Chelondon patoca	Milkspotted blaasop	common	Sometimes very plentiful. Undesirable angling species.
Clinus superciliosus	Super Klipfish	-	Unknown to estuarine sport anglers.
Coracinus capensis	Galjoen	rare	Seldom caught in the estuary. Mainly caught at sea.
Cyprinus sp.	Carp	-	Not recorded in estuarine waters within the study area.
Diplodus cervinus	Zebra	present	Occasionally caught in estuary. Numbers and size decreasing. Average size caught about 1kg.
D. sargus	Blacktail	common	Common in estuary and sea. Mostly small in size - below 1kg.
Elops machnata	Ten pounder	very rare	Unknown to most estuarine fishermen.
Gilchristella aestuarius	Estuarine round herring	present	Not caught on lines. Occasionally recorded by anglers using nets.
Gobius caffer G. multifasciatus G. nudiceps	Banded goby Prison goby Bareheaded goby	common	Sport anglers could not differentiate between the three species of goby. Gobies are plentiful in estuary.

TABLE 10 : Continued

SPECIES	COMMON NAME	STATUS	REMARKS
Hemiramphus far	Spotted halfbeak	-	Unknown to estuarine sport anglers.
Hepsetia breviceps	Cape silver-side	-	Unknown to estuarine sport anglers.
Heteromycteris capensis	Cape sole	common	Caught when trekking for Haarders. Usually small in size.
Hyporhamphus knysnaensis	Knysna half-beak	present	Only caught in nets.
Lichia amia	Leervis	present	On occasions good catches recorded. Before 1960's 20kg fish commonly caught. Declining in numbers and size.
Lithognathus lithognathus	White steen-bras	very common	Good catches throughout the year. Average size caught 2-5kg.
Liza dumerili L. macrolepis L. richardsoni L. tricuspidens	Groovy mullet Largescale-mullet Southern mullet Striped mullet	common	In general, sport anglers did not recognize the difference between these species of mullet.
Micopterus sp.	Bass	-	Not recorded in estuarine waters within the study area. Recorded in the vicinity of Malgas.
Monodactylus argenteus M. falciformis	Natal moony Cape moony	common	Sport anglers did not recognize a difference between these two species. Monodactylus sp. seen, but seldom caught.
Mugil cephalus	Flathead mullet	common	Caught in trek nets for bait.

TABLE 10 : Continued

SPECIES	COMMON NAME	STATUS	REMARKS
Myxus capensis	Freshwater mullet	rare	Recorded by sport anglers on very rare occasions in 1940's and 1950's.
Omobranchus striatus	Blennie	-	Unknown to estuarine sport anglers.
Octolithes ruber	Snapper kob	present	Seldom caught in estuary. Occasionally caught at sea.
Pomadasys commersoni	Spotted grunter	common	Usually good catches in the summer months. In December 1983 several 3-4,5kg fish caught.
P. olivaceum	Piggy	very common	Plentiful in estuary but of low angling importance - too small. Sometimes used for bait.
Pomatomus saltatrix	Elf	common	Good catches during 1984. Still catch fish up to 7kg. Largest recorded 10,9 kg in 1968.
Psammogobius knysnaensis	Knsyna sandgoby	-	Unknown to estuarine sport anglers.
Rhabdosargus globiceps	White stumpnose	present	Occasionally good catches. Several caught during Easter 1984 - average size 0,5kg.
Sarpa salpa	Strepie	common	Recorded mostly in vicinity of river mouth.
Seriola lalandi	Cape yellowtail	very rare	Rarely caught in the estuary. Occasionally good catches at sea.
Siganus canaliculatus	Whitespotted rabbit fish	-	Unknown to estuarine sport anglers.
Solea bleekeri	Blackhand sole	-	Unknown to most estuarine sport anglers.

TABLE 10 : Continued

SPECIES	COMMON NAME	STATUS	REMARKS
Strializa (Mugil) canaliculatus	Haarder	very common	Large shoals frequently seen. Caught in trek nets.
Syngnathus acus	Longnose pipefish	present	Only caught in trek nets.
Tachysurus feliceps	Sea catfish	common	Occasionally seen in large shoals. Usually caught at night.
Trigla sp.	Gurnard	rare	Very seldom seen in the estuary. Sometimes caught at sea.
Umbrina capensis	Baardman	present	Low angling value. Caught near rocky outcrops in estuary.

fish catch record cards were distributed to 40 sport anglers in the study area, totalling 120 cards (see Appendix 5 for an example of the catch cards distributed). Sport anglers were asked to complete a separate record card for each day spent fishing, and were requested to return the completed cards, in an addressed and stamped envelope provided. From the 40 sport anglers only 17 cards were completed and returned. No cards were returned from shore anglers and only two were completed by estuarine fishermen.

In general, anglers are reluctant to disclose their favourite fishing spots and the size of their catches in case this information is used by the authorities to impose restrictions on their fishing activities. This could be one reason for the fairly low response to the cards distributed. Secondly, the cards distributed were those used by the Oceanographic Research Institute (ORI) to monitor linefish catches on a national scale. The title on the card is: SKI-BOAT CATCH RECORD, which may account for the poor response received from both shore anglers and riverboat fishermen, although all anglers were asked to complete the cards irrespective of where they fished. The following analysis, therefore, relates only to catches recorded by sport-anglers from 17 ski-boats.

6.3.1.5 Results

An analysis of the anglers catch data revealed that in terms of mass (41,38% of all fish caught) Kob, Argyrosomus hololepidotus, was the most important fish taken by ski-boat anglers followed by Dageraad, Chrysoblephus cristiceps, and White stumpnose, Rhabdosargus globiceps (see Figure 2). In terms of numbers, Mackerel, Scomber japonicus, (31,15% of all fish caught) emerged as the most abundant angling species followed by White stumpnose, Rhabdosargus globiceps, and Elf, Pomatomus saltatrix (see Figure 3).

During the sampling period 1 083,65kg of bony fish were caught by the 55 anglers covered by the returned fish catch cards. The number of fish caught was 732 (see Table 11). These figures only represent the catches of 17 boats, i.e. data from the cards returned. (See Appendix 8 for details of the number of sport anglers per boat and the number and mass of fish caught per boat.) This is therefore only a very conservative estimate of

i) the actual numbers of sport anglers fishing from ski-boats, and

ii) the total catch made during this period.

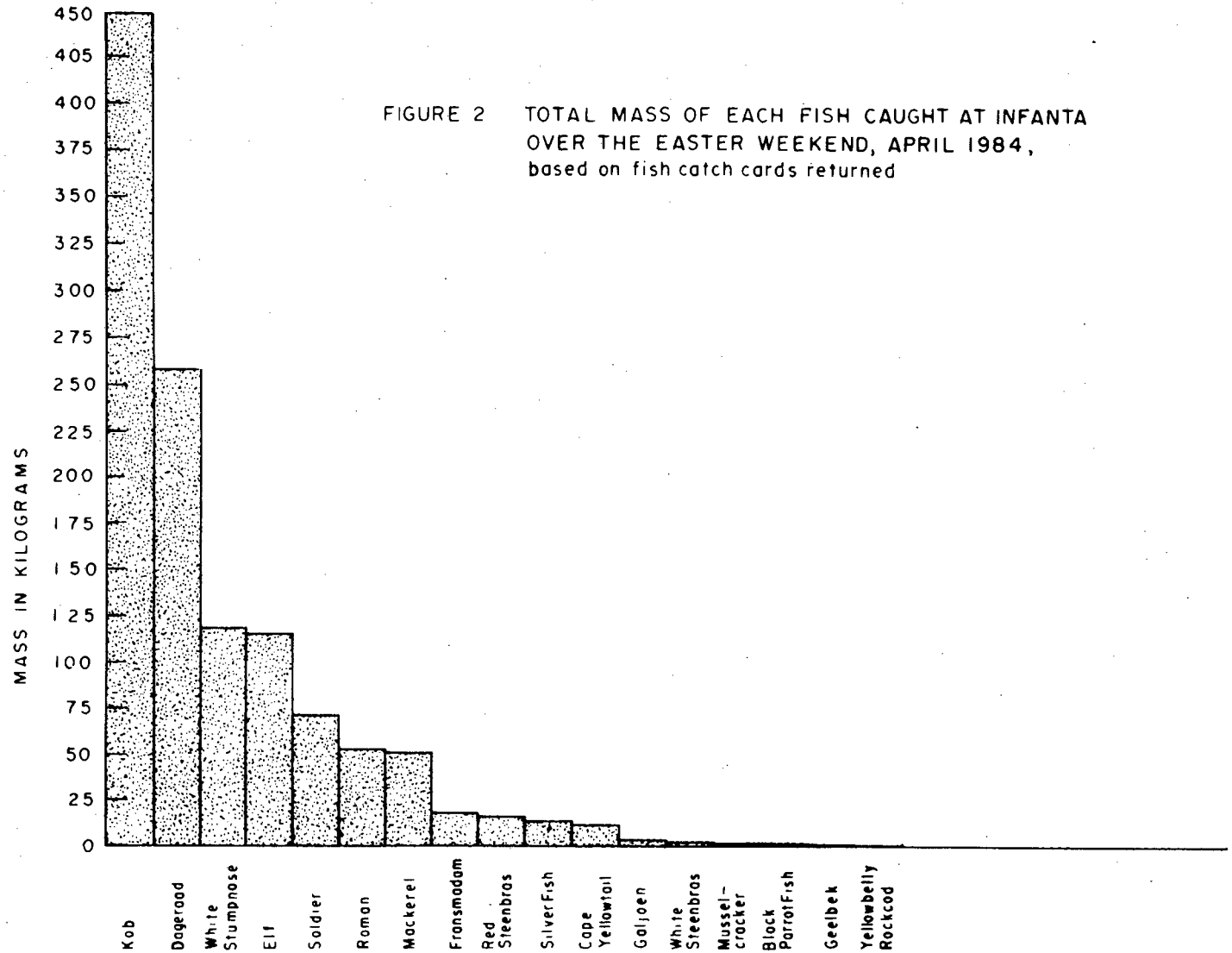


FIGURE 2 TOTAL MASS OF EACH FISH CAUGHT AT INFANTA OVER THE EASTER WEEKEND, APRIL 1984, based on fish catch cards returned

FIGURE 3 TOTAL NUMBER OF EACH FISH SPECIES CAUGHT AT INFANTA OVER THE EASTER WEEKEND APRIL 1984,
based on fish catch cards returned.

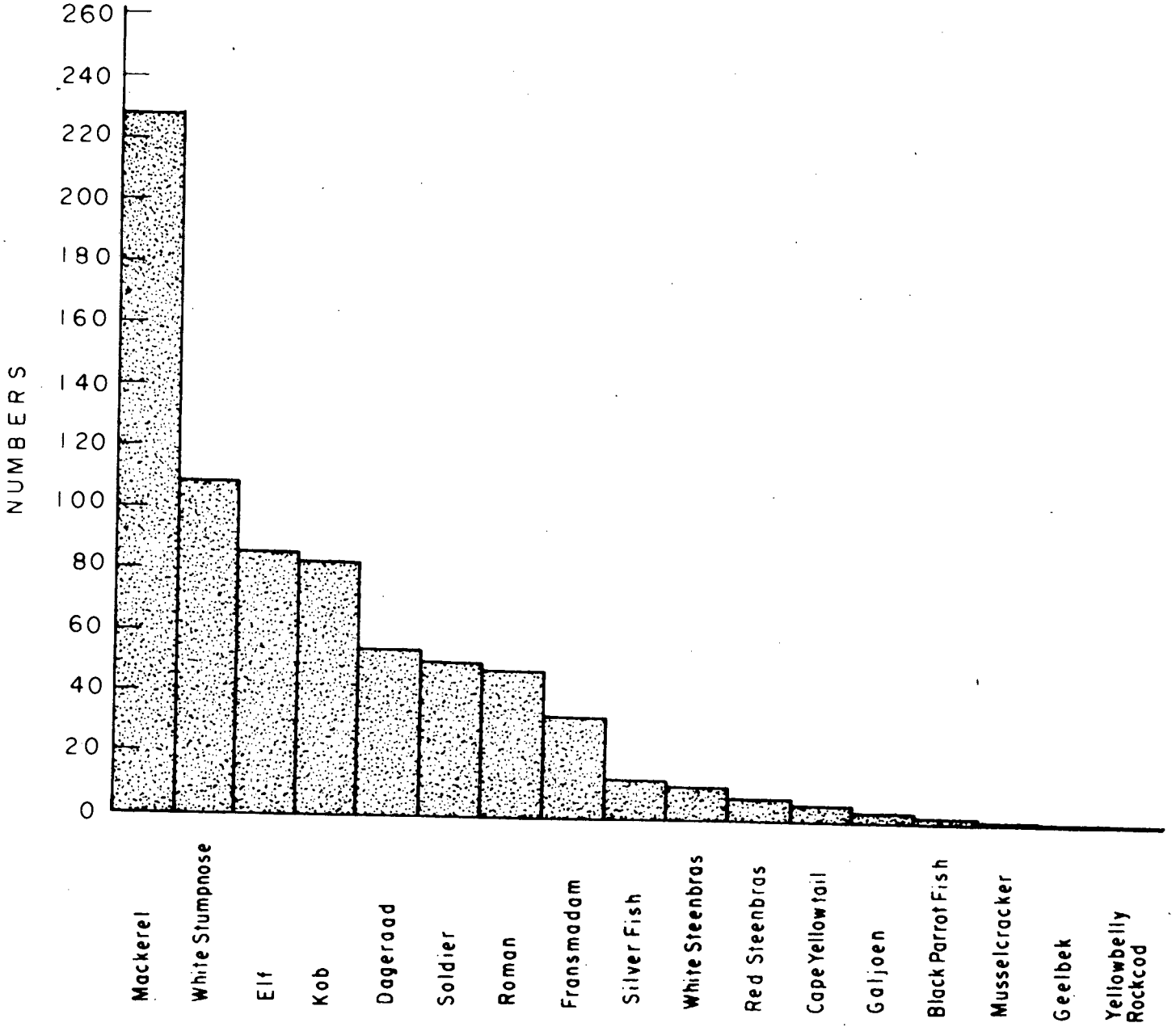


TABLE 11 : Summary of fish caught by ski-boat anglers in St Sebastian Bay over the Easter weekend, April 1984

SPECIES	COMMON NAME	MASS (kg)	NUMBER
Argyrozona argyrozona	Silverfish	12,0	13
Argyrosomus hololepidotus	Kob	448,0	82
Atractoscion aequidens	Geelbek	2,0	1
Boopsoidea inornata	Fransmadam	16,5	33
Cheimerius nufar	Soldier	70,0	50
Chrysoblephus cristiceps	Dageraad	161,0	54
Chrysoblephus laticeps	Roman	52,0	48
Coracinus capensis	Galjoen	3,5	3
Epinephelus guaza	Yellowbelly rockcod	1,5	1
Lithognathus lithognathus	White steenbras	3,35	11
Oplegnathus conwayi	Black parrotfish	3,0	2
Petrus rupestris	Red steenbras	14,0	7
Pomatomus saltatrix	Elf	114,0	85
Rhabdosargus globiceps	White stumpnose	117,0	108
Scomber japonicus	Mackerel	51,8	228
Seriola lalandi	Cape Yellowtail	11,0	5
Sparodon durbanensis	Musselcracker	3,0	1
		Total Mass: 1 083,65	Total Number: 732

6.3.1.6 Discussion

Any method employed for assessing angling impact is fraught with problems and analyses of catch statistics should be viewed in this light. Some of the built-in errors in any recreational fisheries calculations are:

1. Fish returned to the sea are not usually recorded.
2. Very often only results from the more successful fishing expeditions are returned for analysis. Thus days of zero catch are not included in CPUE calculations.
3. So-called sport anglers operating as commercial fishermen during leisure time may be reluctant to disclose actual catches.

In addition, this survey only covered one peak holiday season. Investigations of this nature should be conducted throughout the year as environmental factors such as climatic conditions, migratory behaviour, availability of food and reproductive behaviour could result in seasonal trends of abundance. The results presented in this study are, therefore, not representative of the characteristic of the fishery being examined. But as one of the objectives of this study is to examine current recreational pressure along the Infanta coastal zone during peak holiday periods, results

from catch cards returned after the Easter long weekend, April 1984, do reflect actual fishing pressure by ski-boat anglers over a peak season.

The only published recreational marine angling catch statistics available for the south eastern Cape are from research done by Coetzee and Baird (1980), off St Croix Island in Algoa Bay. Although there are bound to be certain environmental differences between the St Croix area and the Infanta coastal waters, fish distribution maps (van der Elst, 1981) suggest a reasonable amount of overlap of species and consequently the St Croix catch data has been used for comparative interpretation.

In the St Croix study, local angling clubs received permits to spend one weekend per month fishing on St Croix Island. Total catches obtained over the April angling weekend in 1976 and 1977 respectively off St Croix, are compared with total catches made in St Sebastian Bay over the April Easter weekend in 1984. CPUE is expressed as the number of fish caught per man per hour. Mass of fish caught is presented within brackets.

CPUE for the fishing weekend off St Croix Island in April 1976 and April 1977, was approximately 0,65 fish (0,56kg)/man/hour and 0,85 fish (0,86kg)/man/hour respectively, whereas the CPUE for the Easter weekend in April 1984, in the coastal waters off

Infanta, was 2,6 fish (2,8kg)/man/hour. The total catches off St Croix Island for the angling weekends in April 1976 and 1977 were 250 (285,2kg) and 223 fish (324,9kg) respectively. From the census cards returned after the Easter weekend at Infanta, it was calculated that a total of 732 fish (1 083,65kg) were caught by 17 boats over four days (see Appendix 8).

This is an extremely conservative estimate of total catch by Infanta sport anglers over the sampling period, since no catch record cards were returned from shore anglers and only 17 of all cards distributed were returned. From daily counts of boats putting to sea over this period, it is estimated that over the Easter weekend 49 ski-boat fishing trips were made from the Infanta coast. The average number of anglers per boat was 3,24. It is estimated that during the Easter weekend sampling period a total of 3,1 metric tons of bony fish (i.e. 2 110 fish) were caught by 159 ski-boat anglers in 3 244 man-hours. By comparison, in the St Croix study, a total of 2,7 metric tons of bony fish were caught by 343 anglers in 95 697 man-hours (Coetzee and Baird, 1980, p. 18). Although this final comparison is not strictly comparable, since the St Croix figures represent the total catch during the entire sampling period (December 1975 to February 1978) whilst the Infanta

figures represent estimate total catch by ski-boat anglers over the four-day Easter period, it nevertheless provides an interesting comparison.

The catch at Infanta is very high, both in terms of number of fish caught per angler and in total mass. These catch statistics, for the Easter weekend at Infanta, which represent a conservative estimate of fishing pressure by sport anglers, indicate that St Sebastian Bay is still an exceptionally good fishing area despite high recreational pressure.

6.3.2 Bait and shellfish collecting

6.3.2.1 Introduction

Bait collecting is an integral part of the recreational angling activity and consequently sport anglers are attracted to areas where bait is plentiful (ORI Report on Research, 1983). An increase in marine recreational fishing implies a greater pressure on the coastal bait and shellfish resources. In addition to the angling community, many non-anglers collect edible shellfish along the coast as a primary recreation activity. The tremendous importance and value of the bait fishery has recently been recognized by scientists and resource planners alike, and consequently various research programmes on bait resources in South

Africa have commenced.

In the Cape Province, unlike Natal, licences are not required by collectors of bait and edible shellfish. (A licence for collecting crayfish, Jasus lalandii, was introduced in 1983). There are legal limits restricting collectors but because of the lack of policing, especially in more remote areas, little attention is paid to these restrictions. It also appears that many people are simply ignorant of these conservation measures. Evidence of this was obtained from direct observations during the study period of bait collectors, who frequently took in excess of their legal quota, and also from recordings of the number of bait species reflected on bait collection record cards.

Bait census cards were distributed in conjunction with fish catch record cards (see Appendix 5). From the bait record cards it was hoped to gain information on the number of sport anglers collecting bait in the study area, as well as obtain an indication of the major organisms exploited for bait. Only 12 bait collection record cards were returned and of these, six anglers indicated that they bought their bait commercially.

From interviews with sport anglers who have been collecting bait in the study area for over 30 years, from reading the correspondence sent to the Chair-

man of the Ratepayers Association of Infanta giving objections to the proposed extension of Infanta, from aerial photograph interpretation (refer Chapter 4), and from comments on the bait cards returned, there is evidence to suggest that certain bait organisms along the Infanta coastal and estuarine area are indeed decreasing.

6.3.2.2 Shellfish collecting along the rocky coast

From personal diving observations and collecting in the study area over the past seven years, there has been a noticeable decline in the abundance of edible shellfish. Species such as perlemoen, Haliotis midae, Alikreukel, Turbo sarmaticus and oysters, Crassostrea margaritacea, which were previously abundant are now difficult to find along the stretch of rocky coast from Infanta to St Sebastian Point. It is interesting to note that brown mussels, Perna perna, are not commonly collected and eaten by holidaymakers and the rocks directly in front of the Infanta township are heavily colonized. Several people suggested that the lack of exploitation was due to fear of poisoning from mussels contaminated by red tide.

A comparative study of species richness along an exploited stretch of rocky coast in front of Infanta and along a protected rocky shore further west at Noetsie, was begun. This was abandoned

because of time constraints and evidence from surveys conducted by Branch (1980).
These surveys suggest that in terms of species richness there is little difference between sites that are heavily exploited for bait and food organisms and those that are inaccessible and seldom subject to exploitation, but that exploitation is having an impact on both the number and size of species.

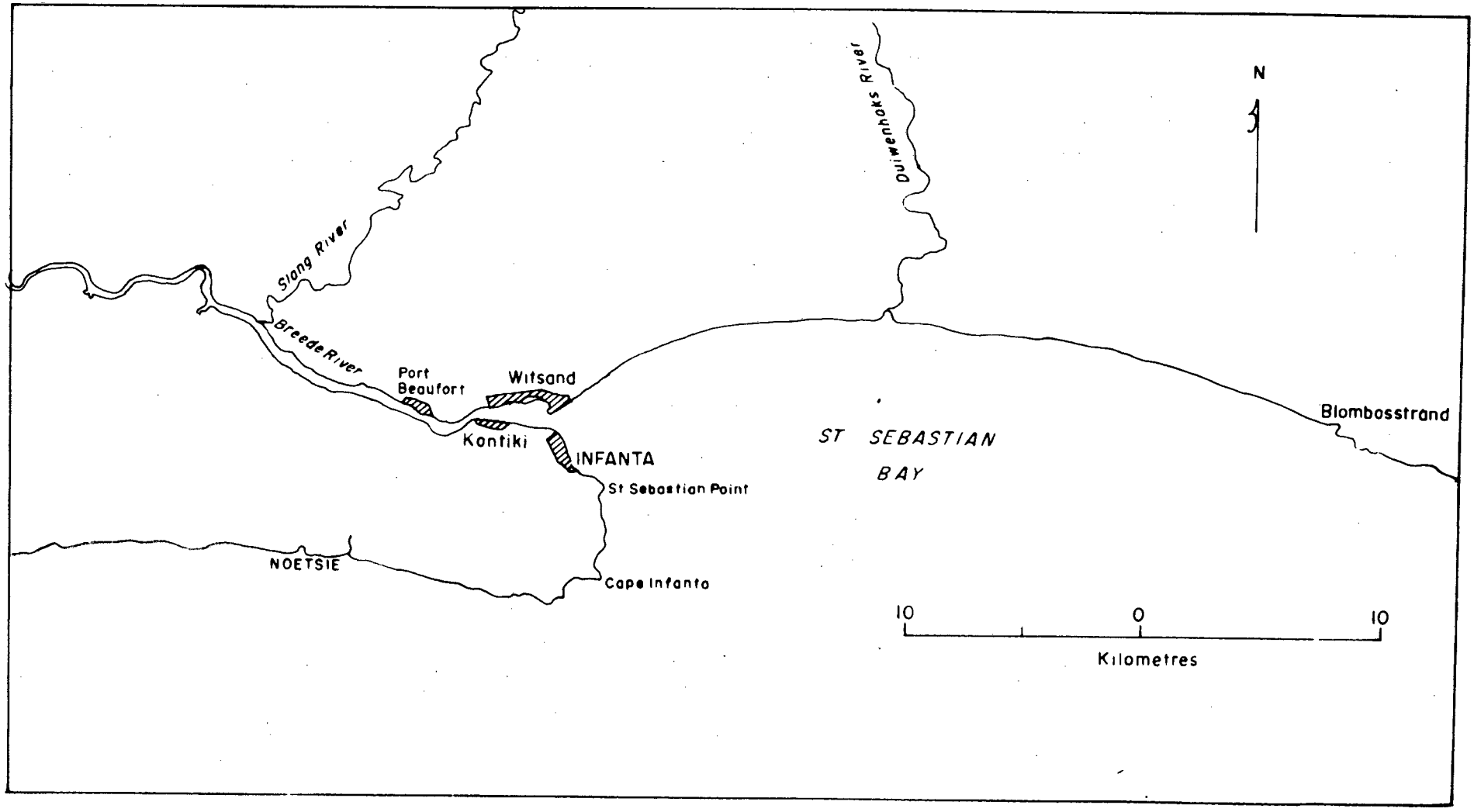
Alikreukel, Turbo sarmaticus, collecting at low tide along the Infanta rocky shore has always been a popular family recreational activity, especially at night with a lamp. But attempts to collect the legal quota of legal sized T. sarmaticus during 1982, 1983 and 1984 proved unsuccessful. This species was consequently selected for comparative investigation.

The segment of rocky coast in front of the Infanta township to the East and West of the slipway, which is heavily exploited during holiday periods, is compared with a section of rocky coast further west, at Noetsie (see Map 6). The Noetsie rocky coast is closed to the public, and only accessible to members of a syndicate who own this stretch of coast, No harvesting of T. sarmaticus has been allowed at Noetsie for the past three years.

The Infanta rocky coast, which faces eastwards,

MAP 6 ST. SEBASTIAN BAY AND ENVIRONS

including Alikreukel, *Turbo sarmaticus,* sampling sites



comprises irregular and deformed rocks of the Bokkeveld Group. The Noetsie site which faces southwards is exposed to heavier wave action than the fairly protected Infanta site. The rocks at Noetsie form part of the Table Mountain Series.

6.3.2.3 Method

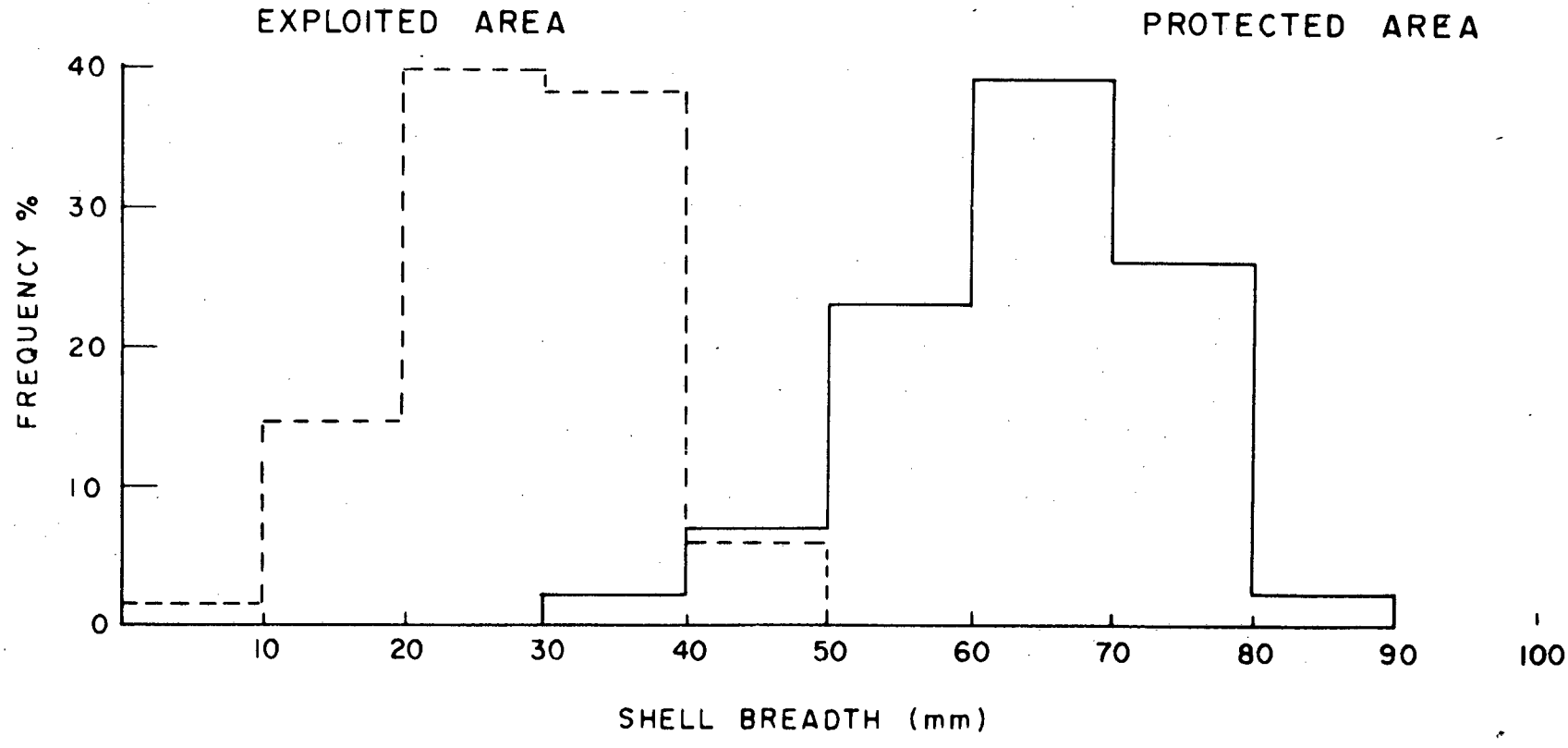
Sampling at two sites in both areas was undertaken between May and August, 1984. Because of the vertical zonation of size classes of T. sarmaticus (McLachlan and Lombard, 1981, p. 221), their entire habitat from the intertidal level down to approximately 1m below the low spring tide level, was sampled at each site. The total area from which the animals were collected was approximately 300^2m in both areas. Animals were collected consistently for a one hour period, measured using vernier calipers, and returned to the sea.

6.3.2.4 Results

Although the two study areas are not strictly comparable in terms of their physical characteristics, the results provide useful supplementary information to anecdotal evidence by property owners of a formerly richer shellfish community along the Infanta coast.

Figure 4 shows the size frequency distribution of T. sarmaticus at the two sites. The catch per

FIGURE 4 SIZE FREQUENCY DISTRIBUTION OF ALIKREUKEL, *Turbo sarmaticus*, COLLECTED FROM AN EXPLOITED AND PROTECTED AREA.



unit effort (CPUE) expressed as the number of T. sarmaticus collected per man per hour, for each sample site, is given in Table 12.

TABLE 12 : Summary of CPUE data of Alikreukel, Turbo sarmaticus

	Exploited Area		Protected Area	
Site	1	2	1	2
CPUE	25	43	83	47

The CPUE of T. sarmaticus in the exploited area was lower than in the protected area and the T. sarmaticus in the exploited area were relatively small. Based on shell breadth: age relationship (McLachlan and Lombard, 1981, p. 226) the results show that T. sarmaticus in the exploited area were much younger than those in the protected area. In fact, no sexually mature animals were found in the exploited area. At Infanta most individuals were well below the legal size limit.

6.3.2.5 Discussion

> 'Humans are size selective predators, removing larger animals first' (Moreno et al. 1984, p. 159).

The presence of small T. sarmaticus in the exploited area as well as the results from the comparative study suggest that the larger animals have been heavily exploited along the Infanta rocky

coast. Furthermore, during a field survey at the Infanta site, 116 empty T. sarmaticus shells were collected on the beach and in the vegetated dunes, within a 20 minute period. Of these 85 were well over the minimum legal size limit of 64mm shell breadth. This suggests that larger T. sarmaticus were present in previous years which endorses the findings of the comparative study.

Unless individuals are left to reach sexual maturity and harvested on a sustained basis, T. sarmaticus collecting as a recreational activity will be a thing of the past. The projected increase in numbers of holidaymakers during peak periods if 'probable' and 'high' levels of development are attained suggest that the marine invertebrate resources along the Infanta rocky coast will certainly be subjected to greater human exploitation.

6.3.2.6 Bait collecting in the estuary

Carter (1983) gives a succinct review of major bait organisms collected from the Breede River estuary. The most popular and successful bait collecting area is off Kontiki, in the fine sands and muds found in the vicinity of the Zostera beds and salt marsh communities. The most commonly collected bait species from this area are the mud prawn, Upogebia africana, and the bloodworm, Arenicola loveni.

Discussions with older Kontiki property owners, with Gaigher, of the Cape Department of Nature and Environmental Conservation, and from aerial photograph interpretation (see Chapter 4) all suggest that the habitat of U. africana is declining. There are two factors which are probably contributing to the decline of this habitat:

1. Marine sands which have been redistributed within the estuary due to natural and man-induced changes have encroached on the Zostera beds. Gaigher (1984) states that even a very thin layer of loose sand moving over the surface is enough to smother a colony of U. africana and cause its decline.

2. Destructive methods of bait collecting such as pumping (instead of blowing organisms out of their holes) and removing cores from the sediment can uproot important grasses and salt march vegetation and destablize the substrate.

In order to obtain an estimate of the density of U. africana, 15x1m² quadrats were randomly placed in the intertidal level in the vicinity of the Zostera beds off Kontiki, and the number of holes in each quadrat counted. The number of holes/m² ranged from 112 to 365 and the mean density was calculated to be 239 holes/m². This figure is

very much lower than the 1 440 holes/m^2 recorded by Gaigher from density studies conducted at the intertidal level, in the vicinity of Greenpoint (see Map 1) in 1979 (Carter, 1983). He estimated a density of 720 individuals/m^2 if all the holes were occupied. By comparison, this recent survey suggests a mean density of 119 animals/m^2 if all burrows are occupied.

This vast difference in density of U. africana suggests that the area off Kontiki is heavily exploited. Furthermore, the legal limit of 50/person/day is often ignored by bait collectors. Since U. africana is sedentary in habit, and its distribution is restricted to the intertidal area down to LWST level, there are no reserve stocks buffering the effects of exploitation.

The bloodworm, Arenicola loveni, on the other hand, is not as sensitive to exploitation due to its wider range of distribution and the existence of an inaccessible subtidal reservoir population. Gaigher (1978) calculated that the available standing crop on the tidally exposed sand island, on the southern bank of the estuary, is approximately 100 000 worms and stated that even if 20% were removed each year, the island alone would provide some 4 000 bait days annually (at the present legal quota of five worms per day). In addition,

he found that there was no reduction in density of A. loveni following heavy human exploitation during the December peak holiday period. He therefore concluded that direct human exploitation would not seriously reduce the A. loveni population, but that indirect human activity which could alter the substrate and habitat would pose a threat to this important bait organism.

Pencil bait, Solen capensis, is also collected in the estuary, in the intertidal sand flats area close to the mouth. There is very scant information on the distribution and status of S. capensis in the estuary and it is thus difficult to assess the present rate of exploitation of this animal. As mentioned in Section 6.3.2.1, very few bait record cards were returned (only 20%). This was disappointing as it was hoped to gain further insight into the availability of this animal for exploitation by recreational fisherman.

6.3.2.7 Current and projected fishing and bait collecting pressure in the study area

Although 76,6% of questionnaire respondents indicated that fishing was an important reason for choosing to holiday in the study area, this figure may only reflect the personal feelings of the respondent and not necessarily that of the group. Since no question explicitly asked for the total

number in each household that participated in sport angling, it was not possible to estimate the number of recreational anglers in the study area during peak holiday periods. This omission represents a shortcoming in the questionnaire design. However, it was hoped that this information would be elicited from fish catch return cards, distributed to all sport anglers over the Easter weekend. Although a fairly good response was obtained from ski-boat anglers, only two cards were returned from estuarine boat fishermen and no cards were received from shore anglers. (See Section 6.3.1.4 for a possible explanation for this poor response.) Similarly, very few bait collection record cards were completed and returned.

From the questionnaire analysis it was possible to determine present numbers of shellfish collectors, spearfishermen and ski-boats used for fishing at sea. Thus projections of fishing pressure at higher levels of development relate only to these recreational fishing activities (see Table 8 for a summary of this information).

Although counts of shore-anglers and riverboat fishermen were made at set times each day, weather and tide conditions influenced where and when anglers fished to such an extent that no meaningful results were obtained. No current or projected

figures for the total number of sport-anglers in the study area during a peak period, are therefore presented.

Estimates of the number of ski-boats used for fishing at sea as well as the total numbers of ski-boat anglers are considered reliable and projections of future ski-boat fishing pressure in St Sebastian Bay, at different levels of development, have been made (see summary Table 8). At the 'current' level of development, it is estimated that 67 ski-boats could be used for fishing at sea during a holiday season. The 'probable' estimate of 84 ski-boats is a realistic figure for the number of ski-boats which could be used in the area, when all the residential erven at the two development nodes are fully developed and the caravan park is 100% occupied. The 'high' estimate of the number of ski-boats used for fishing at sea, calculated from the potential population influx into the area, if an additional 100 residential erven are developed, is 136. With an average of 3,24 anglers per boat, this gives a figure of 441 sport anglers fishing in St Sebastian Bay during peak holiday periods.

Since the study excludes the human pressure imposed on the marine and estuarine resources by Witsands recreationists, the estimates of ski-boat fishermen

using the Infanta statistics alone, could be a very low estimate of angling pressure in St Sebastian Bay.

6.3.2.8 Assessment of physical carrying capacity (Fishing - including bait and shellfish collecting)

As assessment of the physical carrying capacity of the study area for fishing is concerned with the space available to accommodate the current and projected recreationists participating in sport fishing and bait collecting. Here, the focus is not on the number of sport anglers that can be physically accommodated at the fishing sites but rather on the capacity of the ancillary shore facilities to accommodate the increasing number of boats, vehicles and boat trailers expected during a peak holiday period.

An assessment of the physical carrying capacity of the area for boating which includes ski-boats used for fishing at sea, and craft used for fishing in the estuary, is discussed at length in Section 6.3.4.4. In short, the shore facilities required by boats are inadequate to accommodate the projected increase in numbers of boats associated with 'probable' and 'high' estimates of development (refer Table 8).

It is worth noting that it has been estimated that there are never more than 20% of the total number

of boats from an area on the water at the same time (Mr H. Steyn, Chairman, South African Ski-Boat, Light Tackle and Game Fishing Association of South Africa). Contrary to this opinion, questionnaire analysis and daily counts of ski-boats launching from the Infanta slipway indicated that 45-50% could be a more accurate estimate. The following reasons may account for this higher figure at Infanta:

i) There are only three permanent residents in the two townships under consideration.

ii) Most holidaymakers, 91,2%, indicated that they annually visit the area over the Christmas and Easter holiday period (see Chapter 3, Section 3.3.3).

iii) Fishing ranked as the most important recreational activity in the area.

iv) Of the boat anglers, 74% indicated that they fished three to four times a week or more whilst holidaying in the area (see Appendix 1, Question 23). (These statistics must not be considered universal as they could vary from one coastal town to another.)

According to rock anglers, fishing from the rocky coast between Kabeljoubank and St Sebastian is limited because there are only three worthwhile fishing

spots along this 1,6km stretch of coast. These fishing spots are already overcrowded during peak holiday seasons. The fact that shore angling opportunities off the Infanta coast are limited, was raised by several property owners in their letters of objection to further residential development in the Infanta area (see Chapter 1, Section 1.2).

Access to fishing spots beyond St Sebastian Point is limited because the property surrounding the Infanta township is privately-owned and the rugged, rocky nature of this coast discourages fishermen from walking further along the coast. It is anticipated that the projected increase in population associated with the extension of the Infanta township could result in competition for space amongst shore anglers.

6.3.2.9 Assessment of ecological carrying capacity (Fishing - including bait and shellfish collecting)

Until recently, there has been very little research into any aspect of amateur sea angling (Penrith and Loutit, 1981, p. 35), despite the large crop extracted by recreational fishermen.

> 'The impact of sport angling, which is clearly very severe in many areas, needs far more study' (Grindley and Rabie, 1983, p. 266).

The Oceanographic Research Institute in Durban has

recognized the importance of assessing the impact that sport angling is making on the marine fish resources of South Africa and has set up several research programmes to investigate various aspects of recreational fishing. A study on the game fish of the Natal coast has already shown that the Elf, Pomatomus saltatrix, is being overexploited (van der Elst 1976a, 1976b in Coetzee and Baird, 1980, p. 14). Crawford and Crous (1982) have also shown from research along the southern Cape coast that the Dageraad, Chrysoblephus cristiceps, is extremely sensitive to overexploitation even at low levels of fishing. Analysis of catch data from the Cape of Good Hope nature reserve for 1983 gives an extremely low average catch rate over the year of approximately 0,6 fish per angler per day. Evidence of the impact that sport fishing is making on marine fish resources indicates that there is no room for complacency where fish catches are still good.

Improved estimates of the total numbers of holiday-makers participating in sport angling in the Infanta coastal waters, and improved catch data would be desirable for an assessment of the ecological impacts associated with increased sport fishing activities. Consideration of the estimated Easter weekend catch of 3,1 metric tons of fish by 49 ski-boats over a four-day period, suggests that

future angling pressure on marine fish will be excessive if the projected 'high' estimate of 136 ski-boats used for fishing at sea is attained.

Although in ecological terms there is no difference whether marine resources are exploited for recreational or commercial purposes, it should be pointed out that several ski-boat fishermen operating from Infanta sell their catches. With the anticipated expansion of the holiday population and the illicit commercial fishing activities, regulation of catches in St Sebastian Bay may become necessary in future.

In general, from the comments made on fish catch return cards, fish lists distributed and from questionnaire results, sport anglers in the study area maintain that species composition has not changed over the past 10 years. However, they agree that there has been a noted decrease in species abundance and the size of fish caught. A summary of the response to Questions 21 and 22 is presented in Table 13.

Related to the projected increase in fishing activities is greater exploitation of the intertidal bait and food organisms. The deterioration of rock angling along the coast from Koppie Alleen to Cape Infanta has been attributed to uncontrolled exploitation of the intertidal aquatic life (Hey, 1983). A similar deterioration can be expected along this

coast especially if a further 100 residential erven come on the market and 'high' population estimates are reached. Results from the comparative study on Alikreukel, Turbo sarmaticus, revealed that this particular species is already overexploited.

TABLE 13 : Summary of responses to Questions 21 and 22

Question 21. Over the past ten years has it become increasingly more difficult to catch the same number of fish in the same time spent fishing?

Yes	35
No	3
Have not been fishing at Infanta for ten years	6

Question 22. Do you still catch the same kind of fish you caught ten years ago?

Yes	31
No	7
Have not been fishing at Infanta for ten years	6

The question that arises is whether the present, and projected increase in exploitation of marine invertebrates constitutes an unacceptable decline in these marine resources or not. While what constitutes an unacceptable decline ultimately depends on a subjective value judgement, the maintenance of a sustainable yield without depletion of the stock is

a recognized conservation principle. The absence of a viable reproductive size class in the population of a species, as found in the comparative study on T. sarmaticus, (refer Section 6.3.4) must be regarded as an unacceptable decline in an ecological resource.

A brief evaluation of the current and projected human pressure on the estuarine bait organisms follows. A review of the literature available on the major bait organisms exploited in the estuary and findings from investigations conducted during the study, indicate that the habitat of the mud prawn, Upogebia africana, is declining. From daily observations it was clear that collecting U. africana in the estuary was a popular activity and on certain days up to 30 people were counted pumping for prawns at the same time. At low tide ski-boats come over from Witsands and contribute to the exploitation of the bait resources on the southern bank. As mentioned in Section 6.3.2.6, unlike Arenicola loveni, there is no inaccessible subtidal reservoir of U. africana to replace the constantly depleted intertidal population. Thus the projected increase in numbers of recreationists into the area both at the 'probable' and 'high' population estimates could result in the reduced availability of U. africana and place an even greater strain on an already decreasing population. Here again, there

is evidence of a decline in one component of the system which could have secondary impacts throughout the estuarine ecosystem.

Habitat destruction caused by human activities such as trampling, digging and pumping in the productive macrophyte beds and salt marsh areas will reduce the area available for U. africana colonisation which could in time reduce the number of waders feeding on these rich grounds. Furthermore, loss of wetland vegetation will result in lower primary production levels which could significantly reduce the fish population utilizing the estuary.

> 'Research has demonstrated a direct positive relationship between acres of marsh and abundance of fish where a reduction of life support capability of 50% has been estimated after destruction of an associated marsh' (Heydorn, 1984, p. 6).

Thus, increased, uncontrolled exploitation of bait resources and further destruction of habitat could result in an irreversible decline of ecological resources.

6.3.2.10 Assessment of social carrying capacity (Fishing - including bait and shellfish collecting)

> 'Determining carrying capacity ultimately requires the consideration of human values' (Lime and Stankey, 1979, p. 116).

Thus gathering information on the prevailing attitudes of the Infanta recreationists is integral to

an assessment of the recreational carrying capacity of the area for current and increased fishing activities.

An indication of recreationists attitude to present fishing and bait collecting pressures in the study area was elicited from their rating of Question 32 (see Appendix 1). Eighty percent of respondents considered overexploitation of marine resources as a serious problem while overexploitation of estuarine bait organisms was rated serious by 77%. The list of principal objections to the proposed extension of Infanta endorses this view. Clearly, the anticipated increased exploitation of fish and bait resources in the study area which will result if further development is approved will certainly be opposed by the majority of property owners.

It is well known that sport anglers jealously guard their favourite and traditional fishing spots and this opposition to further development in the area can be interpreted as an unwillingness to share a communal resource. It must nevertheless be recognized that social carrying capacity attempts to ascertain what the recreationists themselves perceive as acceptable or desirable, and not what any other group such as township developers or local authorities might consider acceptable. This social assessment, then, reveals that additional exploitation of the fish and bait resources in the Infanta

coastal and estuarine environment would result in a decline in the quality of the recreation experience for the people holidaying in the area.

6.3.3 Watersports

6.3.3.1 Introduction

In the Cape Coastal Survey (1973) reference is made to the statistical predictions of the Bureau of Outdoor Recreation in America which estimates that swimming will become the most popular recreation activity, experiencing growth rates of 72% and 207% by 1980 and 2000 respectively. The authors of the Cape Coastal Survey predict a similar upsurge in numbers participating in swimming in South Africa. According to Lavery (1971, p. 198), swimming is numerically the most important water-based recreation activity in all countries.

Associated with swimming are other physically active watersports such as surfing, paddleskiing, diving, snorkelling and sailboarding, which have all, especially sailboarding, experienced considerable expansion in recent years in South Africa (Mr G. Johnson, Chairman, Boating Industry Association of South Africa). It is estimated that there are approximately 25 000 boardsailors in South Africa at present (Mr C. Carter, Western Province Representative, Boardsailing Association of South Africa). It is thus not surprising that watersports was

ranked high on the list of reasons for holidaying along the Infanta coast (see Chapter 3, Table 4) and as the second most popular recreational activity pursued in the area.

Conditions most suitable for swimming have been carefully researched by recreation and resource planners over the past years. Clear and safe waters, with a sandy substrate and sheltered sandy beach, with water temperatures ranging between 17°C and 22°C are generally preferred swimming conditions (Cape Coastal Survey, 1973, p. 29).

6.3.3.2 Watersports in the coastal and estuarine waters at Infanta

The most popular swimming area at Infanta is directly in front of the township, below the slipway. Because of the rocky nature of the shore this spot provides the only suitable location for swimming along this coast. (The safe area is only approximately 0,5 hectares in extent.) Consequently swimmers compete with boat users for space.

Both surfing and boardsailing are popular recreation activities as indicated by the many boards owned by questionnaire respondents (see Table 8). The only worthwhile surfing spot along the Infanta coast is to the east of the Infanta slipway. Surfers carry their boards over the rocks and paddle out to the breakers, they do not

interfere with persons using the swimming area.

There are no figures for the number of paddleskis used in the study area as this question was unintentionally omitted from the survey. Nevertheless, the few paddleski enthusiasts who have been observed generally launched from the Infanta slipway and either joined the surfers or paddleskied in the swimming area.

During summer the prevailing south easterly wind provides ideal cross-shore boardsailing conditions in St Sebastian Bay. The rocks on either side of the slipway make launching and landing critical and in strong winds only experienced boardsailors venture out to sea.

Good snorkelling and scuba-diving conditions prevail along the rocky coast. With the decline in numbers of edible shellfish (refer Section 6.3.2) it is unlikely that this activity will increase in popularity despite projected levels of population growth.

The estuary is not popular for swimming and diving, probably because of a fear of sharks and the muddy water. Nonetheless sailboarding conditions in the Breede River estuary are excellent. Observations of the major watersports activities pursued at the three publicly accessible recreation sites along the estuary revealed the following patterns of use. At

the Kabeljoubank no-one participated in watersports of any kind due to the rocky substrate and dangerous currents and waves in the vicinity of the mouth. Both the Bar Harbour and Prawn Beds recreation sites provide ideal sailboarding conditions except at low tide when shallow sand banks cause difficulties. When the south east wind blows, safe cross shore conditions prevail and boardsailors can sail for approximately 1,2km across the northern bank of the estuary. With the rapid increase in boardsailing in South Africa, it is anticipated that the Breede River Estuary will become a popular windsurfing spot during peak holiday seasons.

6.3.3.3 Current and projected increases in the numbers participating in watersports

From questionnaire respondents alone, 38 people indicated that they owned a sailboard which would be used during the holiday period, while 43 people had surfboards. Yet the maximum number of people seen boardsailing at any one time was 19 and the maximum number of surfers was six. This points to the importance of supplementing direct observations with quantitative information which can be obtained from questionnaire analysis. This complementary information provides an estimate of the potential pressure that could be expected if all surfers and boardsailors were active simultaneously.

From statistics extracted from the questionnaires projections of the rates of growth of boardsailing and surfing at Infanta have been made. At 'current' population levels, 63 sailboards and 75 surfboards could be used by recreationists in the study area, while 80 windsurfers and 95 surfboards are anticipated when all erven in the study area are developed and the caravan park is fully occupied. Projections of watersports activities associated with the proposed development at Infanta, would significantly increase these figures to 129 sailboards and 153 surfboards during peak holiday periods. (Refer Table 8 for a summary of these statistics.) Resource planners and regulators of township development should consider figures of this type in the planning and development of townships and recreation resorts along the coast.

6.3.3.4 Assessment of physical carrying capacity (Watersports)

Most watersports activities are combined with more passive beach activities such as sunbathing (ranked fifth on the list of major recreational activities pursued in the study area) beach sports, and reading. In the following discussion of the physical carrying capacity of the area to accommodate watersport activities, it is therefore necessary to consider the capacity of the supporting beach area.

In front of the Infanta township the beach area is

extremely small; approximately 50m long and 5m wide at low tide. The beach is, for all recreation purposes, non-existent at high tide. Along the Breede River estuary there is a narrow strip of sandy beach stretching from the mouth to Infanta Extension One. This beach is also covered by water in certain places at high tide.

Because of the importance of the beach zone for associated water-based recreation activities, various recreational and resource planners have attempted to determine standards for beach capacity (Cape Coastal Survey, 1973; Baud-Boyd and Lawson, 1977; Outdoor Recreation Resources Review Commission, 1962). Standards differ depending on factors such as the physical characteristics of the beach, the proximity of the beach to an urban centre and management objectives. The usual standards for beach capacity adopted by a number of countries are presented in Table 14. In southern Africa a standard of 1,5 persons per metre of coast (i.e. 30m² per person where the average depth of the beach is 20 metres), has been used for the major coastal resorts of the Transkei. The rationale is that beaches located in remote areas should project an image of solitude and thus a low density of people is desirable (Mr M. Kerr, Development Officer, Transkei Development Corporation). In the Cape Coastal Survey (1973) an area of 100 square feet (approximately 9m²) of beach

TABLE 14 : Usual Standards for Beach Capacity

USUAL STANDARDS FOR BEACH CAPACITY (FACILITIES NOT INCLUDED)

	m^2 per person	Persons per metre of coast			Metre of coast per person			Sq ft per person
		Depth of beach 20m	33 m	50m	Depth of beach 20m	33m	50m	
Over-density	3	6,5	11,0	16,5	,15	,10	,05	35
Public beach near town	5	4,0	6,5	10,0	,25	,15	,10	55
Public beach (average)	8	2,5	4,0	6,0	,40	,25	,15	85
Resort (low standard)	10	2,0	3,5	5,0	,50	,30	,20	110
Resort (medium standard) Public beach (High standard)	15	1,5	2,0	3,5	,75	,45	,30	160
Resort (comfort)	20	1,0	0,5	2,5	1,0	,60	,40	215
Resort (de luxe)	30	,7	1,0	1,5	1,5	,90	,60	320

SOURCE: Baud-Bovy and Lawson, 1977. p. 74.

per person has been recommended for beaches near urban centres.

An appropriate classification for the Infanta beach is resort (medium standard) or public beach (high standard) - see Table 14. The recommended beach space per person for this category of beach is 15m² (i.e. 1,5 persons per metre of coast where the average depth of the beach is 20 metres).

From direct observations at Infanta, during favourable weather conditions in the summer holiday season, counts of up to 250 people on the beach were made, the average being 165. As mentioned, the beach area at low tide is only 250m². If the standard recommended for a resort (medium standard) is used, the area of beach per person, assuming average beach attendance, would be 1,5m². When the maximum number of people (250) are on the beach, only 1m² of beach would be available for each person. These figures reveal how inadequate the beach area is, to accommodate even the present population.

From daily observations the beach along the estuary did not get overcrowded, probably because very few people swim in the estuary. People tend to congregate at points of access but spread out by walking further along the beach. This stretch of estuarine beach provides the only suitable place for leisure walks since the land surrounding the development

nodes and the caravan park is privately owned. Friends and family members not participating in bait collecting or water-based recreation activities usually spend their time walking along this beach. Further upstream, in the vicinity of The Jetty, there is no beach.

Baud-Boyd and Lawson (1977, p. 74) indicate that 40-70% of residents of a coastal resort may be on the beach at the same time. Assuming that 55% of the 'probable' population estimate of 1 127 people are on the beach, 620 people may be on the beach simultaneously. The average beach area per person would be 0,4m², well below the standard recommended for a resort of medium standard (see Table 14). Calculating the beach area available per person for the 'high' estimate of 1 817 people in the same manner, yields 0,25m² of beach per person. It is clear that the limited beach space at Infanta is one of the major constraints for further recreational development in the area.

Since the proposed township extension site is adjacent to the Infanta village, the greatest recreational pressure will be at the Infanta beach and swimming recreation site. The proposal to build a tidal pool (see Chapter 1, Section 1.2) may alleviate the swimming congestion problem but would not solve the lack of beach space along the Infanta coast.

A consideration of the spatial requirements for boating activities and the projected increase in numbers of recreational craft is discussed in Section 6.3.4.5. Since there is no activity zoning in the Breede River, the projected increase in the number of boardsailors using the estuary could result in conflict between different boating groups. Sailing craft are dependent on wind direction while power- and rowingboats have greater freedom to choose their own course. With the projected growth in numbers of all recreational craft in the area, the potential for accidents is greatly increased. Consequently, it may become necessary to introduce activity zoning in the Breede River estuary. Although segregation of incompatible recreation activities would reduce potential danger, it would further limit the physical carrying capacity of the area.

6.3.3.5 Assessment of ecological carrying capacity (Watersports)

There are no ecological effects associated with swimming in the coastal and estuarine waters at Infanta, since the swimming areas are open to the sea and constantly flushed by wave and tidal action.

In a recent study on the effects of recreational activities on aquatic avifauna, Rowlands (1984) found that after powerboating, boardsailing caused

the greatest disturbance to birds. But as boardsailors tend to sail a course to and from their launching site, the area they disturb is relatively small. Since there are only two suitable launching sites along the south bank of the Breede River estuary, boardsailors tend to sail in the vicinity of these access points. Disturbance to bird populations by present numbers participating in the sport is considered fairly low, causing only local and seasonal disturbance.

However, with the increase in numbers of boardsailors associated with 'probable' and 'high' levels of development (see Table 8), boardsailors will have to spread out along the estuary to avoid collisions. Consequently, disturbance to bird populations will be much greater.

Associated with more sailboards in the area is an increase in the numbers of people trampling over the salt marshes in the vicinity of The Jetty. The ecological effects of human trampling on terrestrial vegetation and soil have been well researched and documented (Tivy and O'Hare, 1981; Wall and Wright, 1977; Lime and Stankey, 1979; Lapage, 1967; Lavery, 1971) but there is no published literature on the effects of trampling on salt marsh vegetation. Degradation of the salt marsh area is discussed in Section 6.3.4.6.

Research on the impact of activities associated with recreation such as human trampling, dragging boats, driving vehicles and anchoring boats on salt marsh vegetation needs investigation. At the Breede River site a comparative study of a heavily utilized salt marsh and an unused area at an inaccessible site could provide insights into the effects of human activities on these productive ecosystems. This was not possible in the time available for this study.

6.3.3.6 Assessment of social carrying capacity (Watersports)

Overcrowding on the Infanta beach and in the swimming area constitutes a negative social impact and is considered a serious problem by 65% of questionnaire respondents. (See Appendix 1, Question 32, for the exact wording of this question.) Response to Question 26, 'Do you think the existing beach facilities can support more people at peak holiday periods?' was an overwhelming NO (93,5%); an indication of present perception of the carrying capacity of the area. In addition the major objection listed by property owners to further development at Infanta is lack of beach space, and the fact that boating and swimming share the same area. (The conflict between boat users and swimmers is discussed further in Section 6.3.4.)

It is interesting to note that only 57,1% of respon-

dents were opposed to a tidal pool being built at Infanta (see Appendix 1, Question 26), while 83,1% indicated that they would not support the extension of Infanta township even if a tidal pool were built (see Question 28). Clearly, property owners and recreationists are opposed to further development in the area and would be prepared to forego the additional swimming facilities which would be provided if more residential erven were developed. One of the principal objections to the extension of Infanta listed by Infanta property owners is changing the undeveloped coastal township atmosphere by introducing additional man-made recreational facilities.

Crowding on the beach and congestion in the swimming area at present population levels has apparently already led to a decline in the enjoyment and satisfaction previously experienced at the Infanta recreation site. Thus the projections of population numbers associated with 'probable' and 'high' levels of development would certainly exceed the social carrying capacity of the area for watersports activities.

6.3.4 Boating

6.3.4.1 Introduction

In recent years boating has experienced considerable

diversification and encompasses a varied range of activities including canoeing, rowing, sailing, powerboating, hydro-planing, water-skiing and cruising (Lavery, 1971, p. 199). In the constitution of The Boating Industry Association of South Africa, boating is defined as any craft that floats, has a mass of less than 50 tonnes and is used for pleasure (Mr G. Johnson, Chairman, Boating Industry Association of South Africa). Canoes, rowing-boats, sailing and fishing dinghies, yachts, power-boats, sailboards, surfboards and paddleskis are all included in this definition.

Of all recreational activities, boating is projected to undergo the greatest popularity growth in the coming decade (Ketchum, 1972, p. 85). An increase in recreational craft in the United States from 2,4 million in 1947, 8 million in 1971 (Lavery, 1971, p. 200) to 13 million in 1982 (Mr D. Abromowitz, Representative, Boating Industry Association of South Africa) is indicative of the development of boating as a popular recreational pursuit. In South Africa a similar trend is in evidence. The only authoritative index of such increased popularity in boating in South Africa are figures of importation of recreational craft and accessories. These show a marked increase since 1978 (Mr G. Johnson, personal comment). In addition, the introduction and rapid growth of boardsailing in

South Africa is likely to increase boating interest since sailboard dealers predict many boardsailors will either diversify their boating activities and require additional craft, or may progress to bigger boats.

In the analysis of boating pressure at the Infanta site, boardsailing, paddleskiing and surfing are excluded as these recreational activities have been discussed in Section 6.3.3.

6.3.4.2 Boating in the coastal and estuarine waters at Infanta

The study area provides boat users with the option of boating at sea or in the more sheltered estuarine waters, depending on weather conditions. That 72% of boat owners use their boats three to four times per week or more, whilst holidaying at Infanta, is not surprising. Boating ranked third on the list of recreational activities most commonly pursued and 65% of questionnaire respondents owned one or more boats. The range of activities pursued by boat owners is listed in Table 15, in order of popularity, indicating the percentage of participants in each activity.

TABLE 15 : Activities pursued by boat users

Boating Activities	% of participants
Fishing at sea	70
Fishing in the river	68
Pleasure trips on the river	53
Pleasure trips at sea	30
Diving at sea	26
Waterskiing on river	19
Birdwatching on river	19
Waterskiing at sea	13
Birdwatching at sea	4

6.3.4.3 Access to boating sites

The Infanta slipway provides the only suitable launching and landing site for recreational boats along the rocky coastline. The slipway leads into a natural, fairly sheltered channel, approximately 8 metres wide and flanked on either side by rocks. All recreational craft must navigate this channel which corresponds with the only safe swimming area at Infanta.

Frequently during peak holiday periods, three to four vehicles trailing boats queue above the slipway while several boats wait at sea beyond the channel for a clear approach. Swimmers, especially children, are forced to clear the area for their own safety when boats are launched or beached. While at sea boat owners park their vehicles and trailers on the

commonage near the slipway. The only public open space for picnicking and braaing, is thus reduced due to vehicle and trailer parking. During a peak season, in favourable weather conditions, this commonage is filled to capacity with vehicles and boat trailers and other use is impossible.

Since all the land along the south bank of the Breede River estuary in the study area is privately owned, access to the estuary is only by way of three public access roads: one leads to Kabeljou-bank, one to the Prawn Beds and one to The Bar Harbour (refer Map 2). The latter access road leads to a 300m stretch of shore from where boats can be launched. Boat trailers are either driven over salt marsh to the water's edge or boats are dragged and carried, depending on size. There are no public boat ramps on the south bank of the estuary. Smaller craft, such as canoes, which can be carried, can be launched from the Prawn Beds access point.

6.3.4.4 Current and projected boating pressure in the study area

From questionnaire analysis and direct observations, it was established that 84 boats were used in the study area during a peak holiday season. Of these, 70% of boats were used at sea while 80% were used for recreation in the estuary. Table 8 presents a

detailed breakdown of the present and potential boating pressure in the area. In brief, the 'low' estimate of number of boats used for recreation in the study area is 122. The 'probable' estimate is 154 boats, and the 'high' estimate calculated from population numbers expected if 100 additional houses are built at Infanta, is 248 boats.

6.3.4.5 Assessment of physical carrying capacity (Boating)

Existing access and egress points for boat launching and landing, as well as parking facilities for boat trailers at the water-based recreation sites in the study area are already inadequate to accommodate the boating pressure. The situation will worsen if 'probable' and 'high' estimates of numbers of boats are attained.

The size of the commonage at Infanta is 95m x 30m in extent, of which 30m x 37m is accessible for parking. This area can thus accommodate at most 25-30 vehicles with boat trailers.

From direct observations, it was calculated that ski-boat owners take on average ten minutes to launch and 12 minutes to land their craft. In this study, it has been shown that 45-50% of ski-boats could be on the water simultaneously (refer Section 6.3.2.8). Thus a realistic estimate of the number of ski-boats requiring launching facilities at 'current' population levels would be approximately

30. Launching time alone for 30 ski-boats would amount to approximately five hours. Even if boat launching starts at 06h00, boat launching alone would take until 11h00, by which time many boats would be ready to return to shore.

This focal recreation site would thus be dominated by boating activities and conflicts between different interest groups could arise. Clearly, with the projected increase in boat numbers in the area, one slipway will be inadequate to serve all recreational craft.

Along the Breede River estuary, 300m of shore stretching from The Jetty to a privately-owned boundary fence is accessible to boat users from the Bar Harbour access road. A tract of salt marsh approximately 250m by 7m has been cleared between these boundaries to provide space for vehicles and boats. From field measurements it has been estimated that this area can accommodate 60 vehicles, or half that number for vehicles with boat trailers. From direct observations during the study period, there was no evidence of congestion at this parking and launching site. Similarly, at the Prawn Beds parking area, from where smaller recreational craft are launched, space was not a problem.

At 'current' levels of use and even at projected 'probable' levels of use, the area could accommodate

the additional boating pressure. However, with the increase in boat numbers from 154 to 248 boats, associated with the proposed extension of Infanta, additional access roads, boat launching ramps and parking areas will have to be provided.

Recreational boating, especially powerboating, is extremely space demanding. Results from research conducted in North America suggest that the spatial requirements for boating vary from three acres (approximately 1,2ha) per boat for general purposes, up to 40 acres (approximately 16ha) per boat for water-skiing (Jaakson, 1970 in Pigram, 1983, pp. 135-136). Since no water-skiing is allowed in the the Breede River estuary between the mouth and where the Slang River tributary joins the Breede River (Cape of Good Hope Provincial Proclamation 357 of 1972) it will not be considered in the boating spatial requirements assessment. Nevertheless it should be noted that many water-skiing enthusiasts ignore this regulation.

From research in North America an overall standard of ten acres (approximately 4ha) per boat has been recommended. This figure agrees with the recommended space standards for general purpose boating at Zeekoevlei, in Cape Town (Cape Coastal Survey, 1973).

There are no space problems associated with boating at sea. The water space for boating on the estuary

within the study area encompasses an area of approximately 300 hectares. Assuming that 45% of boats are on the water at the same time (refer Section 6.3.2.8) the following space standards would be achieved at the different levels of development. At the 'current' level of development in the study area, the number of boats on the estuary is estimated to be 97. (Refer to Table 8 for these statistics.) If 45% of this figure are active, 44 boats would be on the water at the same time; 6,8 hectares per boat would be available.

The 'probable' estimate of numbers of boats using the estuary is 122. Therefore, when 'probable' population levels are reached, 55 boats could be using the estuary simultaneously. This gives a figure of 5,5 hectares per boat, which is still within space standards recommended for general purpose boating.

However, at 'high' levels of development, it is anticipated that 197 boats will be used for recreation on the estuary. Forty-five percent of this figure suggests that 89 boats could be on the water at the same time. This would result in 3,4 boats per hectare, which falls below the recommended space standards for boating.

It must be recognized that these projections are only concerned with the boating activities of

recreationists launching from the southern bank of the estuary. Rapid development on the northern bank of the river, at Witsands and development at the Breede River Resort, approximately 15km upstream, make projections of the total numbers of boats using the estuary for recreation difficult. Thus, the projections of boating pressure on the estuary are a conservative estimate of the actual numbers of boats that could be on the water at the same time.

6.3.4.6 Assessment of ecological carrying capacity (Boating)

In a recent review of recreational guidelines applicable in South Africa, (Mulder et al., 1984) contend that damage to the environment caused by boats is debatable. On the other hand (Pigram, 1983; Clark, 1977; Lenanton, 1974; Heydorn and Tinley, 1980; Tivy and O'Hare, 1981) have boldly linked bank erosion and turbulence to powerboating.

No quantitative evidence exists which specifically relates numbers of boats, speed, frequency of use, to rate of erosion. This would be difficult to prove conclusively, since other natural or man-induced changes to the system may simultaneously be contributing to the erosion process. It is therefore only possible to postulate that the increased boating in the estuary is contributing to bank erosion which is especially visible at the major

boat launching site in the vicinity of The Jetty. Towards the mouth, bank erosion is not a problem because of the sandy nature of the substrate.

Without the provision of adequate boating facilities and stricter enforcement of the speed of power craft, it is projected that the increase in boating will exacerbate the erosion process. In addition, Lenanton (1974, p. 121) states quite categorically that outboard engines destroy the benthic inverterbrate habitat, and increase the turbidity of the water in shallow areas of estuaries. Heydorn and Tinley (1980, p. 68) maintain that noise and oily emissions from outboard engines are deleterious to aquatic and bird life. Thus increased boating activities could lead to secondary impacts in the estuarine system.

The destruction of salt marsh vegetation can also be linked to boating activities and further deterioration is expected even at present levels of use because of inadequate ancillary shore facilities for boats. Loss of salt marsh area is contrary to one of the recommendations made by (Carter, 1983, p. 36)which states that salt marsh areas in the Breede River estuary must be conserved with vigour because of the important role they play in estuarine ecosystems.

The Breede River estuary provides suitable habitat

for approximately 177 bird species, of which ten are regarded as being rare, vulnerable or threatened (Siegfried et al., 1976 in Carter, 1983). The estuary and associated wetlands is an important feeding area for migrant waders and provides suitable breeding grounds for 45 of the 177 species (Carter, 1983, p. 30). The effects of recreational activities, including different recreational boating activities, on aquatic avifauna has recently been investigated by Rowlands (1984). He concluded that active powerboating causes greatest disturbance to avifauna (Rowlands, 1984, p. 74). Projected increases in numbers of powerboats in the study area (see Table 8) suggest that greater disturbance to the bird population is inevitable. The ecological ramifications of a reduced bird population, the top predator in the estuarine system, could be far-reaching. For this reason, it was suggested that a regular census of the waders (Charadrii) should be undertaken, in order to monitor the biological status of the estuary (Carter, 1983, p. 30).

6.3.4.7 Assessment of social carrying capacity (Boating)

The major social problem at the Infanta recreation area is the limited capacity of the water surface and shoreline to accommodate a number of competing recreational uses. Dissatisfaction over the current situation was clearly expressed by holiday-

makers in their response to Question 32 (see Appendix 1) which listed potential problems facing the Infanta environment. Congestion of boats in the swimming areas was recognized by 73% of people as a serious problem while 52% added to this list "swimming in the boating area" as a potential source of conflict.

The projected increase in boating (see Table 8) implies more boats queuing to launch and land, more congestion in the communal swimming and boating area and thus greater conflict between different users. From discussions with holidaymakers and questionnaire replies, it is apparent that further boating pressure in the limited area would significantly reduce the recreational experience not only for the more passive watersport enthusiast but also for boat users.

Along the estuary a serious social impact associated with boating is the noise generated by powerboats. Noise from outboard engines has direct impact on holidaymakers seeking a peaceful vacation in a semi-natural environment and also directly affects river fishermen. Since 'getting away from it all' and 'lack of development' ranked first and second respectively, as the most important reasons for holidaying in the study area, (see Chapter 3, Table 4) the projected increase in the number of

outboard engines associated with 'probable' and 'high' levels of development would result in more noise and would certainly reduce the peaceful, tranquil quality associated with the holiday experience. Many anglers expressed their dismay at the increasing number of powerboats on the estuary since 'Every fisherman knows that an approaching motor boat may scare away the fish' (Clark, 1977, p. 673).

6.3.5 Walking and hiking

Walking and hiking ranked fourth on the list of major recreational activities pursued in the study area. However, walking and hiking opportunities in the study area are extremely limited since all land surrounding Infanta, Kontiki and the caravan park is privately-owned. There is a footpath from the Infanta village to St Sebastian Point, on the hillside to the west of Infanta (see Map 2). This path is on privately-owned property but the owner does not object to holidaymakers using it (Mr J. Klosser, property owner, erf 107). People also walk on the narrow strip of beach, adjacent to the estuary, at high tide.

From the above, it is clear that walking and hiking opportunities in the study area are extremely limited, thus a detailed assessment of the recreational carrying capacity of this activity is not given.

6.3.6 Conclusions

From this detailed assessment of the recreational carrying capacity of the study area, the major physical, ecological and social constraints associated with current and projected levels of recreational use have been isolated and identified. The recreational constraints for further development in the study area will be summarized in the concluding chapter.

CHAPTER 7 : MAJOR CONSTRAINTS FOR FURTHER DEVELOPMENT AND CONCLUSIONS

A detailed assessment of recreational carrying capacity of the coastal and estuarine environment at Infanta, South Cape, has indicated the range of capabilities of the environment for recreation and related human activities at current and projected population levels. Major physical, ecological and social constraints for further residential development have been identified.

7.1 Physical Constraints

7.1.1 The beach and swimming area at Infanta are extremely limited. At present population levels recommended standards for beach capacity are already exceeded. An increased holiday population would require additional swimming facilities such as a tidal pool. Although a prospective developer could be required to finance the construction of a tidal pool, lack of beach space is the major limiting factor for further development.

7.1.2 Existing ancillary shore facilities for boats are inadequate to support 'current' boating pressure. Additional boat ramps, parking areas and access roads will have to be provided if further development is approved. These costs will have to be met by either the developer or local authority.

7.1.3 An increase in the number of recreational craft

utilizing the Breede River estuary would result in congestion of the water surface, since the recommended standard of ten acres (approximately 4ha) per boat (Pigram, 1983, p. 136), would be exceeded. It is anticipated that with rapid development on the north bank of the estuary at Witsands, conflicts between different recreational interest groups will occur. It may become necessary to introduce activity zoning in the future.

7.1.4 All land surrounding Infanta, Infanta Extension One and the caravan park is privately-owned. Opportunities for walking and hiking are thus extremely limited.

7.2 Ecological Constraints

7.2.1 Fishing opportunities and fish catches in the Breede River estuary and coastal waters of Infanta are good. However, there has been a decrease in species abundance and size of fish caught over the past ten years. It is unlikely that the same good quality of fishing will be maintained at higher levels of exploitation.

7.2.2 Overexploitation of particular bait and shellfish organisms has already occurred. Greater exploitation of marine intertidal life could result in deterioration of rock angling along the coast as well as reduce the numbers of edible shellfish available for collection. Decline in numbers of mud prawn, Upogebia africana, due to direct exploitation and destruction of habitat would be intensified by additional pressure on this important bait species. A decline in one component of an ecological system could have

secondary effects throughout the ecosystem.

7.2.3 Destruction of salt marsh vegetation and severe bank erosion in the vicinity of the Bar Harbour is directly related to boating and watersports activities. Increased recreational pressure in this sensitive zone would result in further destruction of these productive biological systems and accelerate the process of bank erosion.

7.2.4 An increase in the number of recreational craft, especially powerboats, utilizing the estuary would cause disturbance to bird populations. The ecological ramifications of a reduced bird population, the top predators in the estuarine system, could be far-reaching.

7.3 Social Constraints

7.3.1 Overcrowding and congestion at major recreation sites would be intensified by an additional holiday population. This would constitute a negative social impact to present holiday populations.

7.3.2 Recreational facilities are inadequate to support increased human pressure during peak holiday periods. Provision of additional recreational amenities would change the undeveloped coastal township atmosphere. Such changes are strongly opposed by the majority of property owners in the study area.

7.3.3 'Current' levels of exploitation of marine and estuarine resources are considered a serious environmental

problem by the present holiday population. An increase in the number of people exploiting the coastal resources would reduce fishing and bait collecting opportunities for both present holidaymakers and newcomers to the area.

7.3.4 Noise generated by outboard engines has a direct negative impact on visitors seeking a peaceful holiday in a semi-natural environment. An increase in the number of powerboats using the estuary would reduce the peaceful, tranquil quality associated with the holiday experience at the Breede River estuary.

7.4 Other Constraints

7.4.1 The local authority has no servitude property in the study area. Refuse is dumped on privately-owned property behind the Infanta village. This constitutes a health hazard and a visual blight. Increased residential development would aggravate this unsatisfactory situation.

7.4.2 In the past a shortage of water restricted development in the study area. In recent years, boreholes have been sunk and potable water has been found. However, the extent of this coastal groundwater system is unknown.

> 'Theoretically, any extraction of groundwater from a coastal system will cause a readjustment of the saltwater interface landward' (Clark, 1977, p. 641).

Since only two percent of saltwater mixed with freshwater makes the water unpotable, saltwater intrusion is a poten-

tial problem in coastal aquifers. Increased residential development and consequently increased extraction of groundwater could result in saltwater intrusion. It is therefore imperative that the extent of the groundwater system be investigated before further development is considered.

7.4.3 Septic tanks, used by the majority of property owners in the study area for the disposal of household sewage, are a potential source of groundwater pollution. This endorses the necessity for investigating the location and extent of the groundwater system in the study area before further residential development is approved.

7.4.4 Disturbance to the ground caused by construction activities and increased human and vehicular movement in the area will encourage the spread of alien Acacias.

7.5 Conclusions

7.5.1 The principal conclusion of this study is that both the environmental resources and the existing man-made amenities in the study area are already stressed by holiday-makers during peak holiday periods: an increase in the holiday population will cause the recreational carrying capacity to be exceeded.

7.5.2 Increased development in the study area will lead to a deterioration of the qualities which have attracted holidaymakers. Increased human pressure will reduce the quality of the recreational experience for both the present

holiday population as well as the additional population which will be attracted to the area because of the qualities which currently exist.

7.5.3 This assessment of recreational carrying capacity has indicated that only very limited redevelopment should be permitted in this area. New developments which will increase population numbers during peak holiday periods should not be permitted.

7.5.4 An evaluation of present recreational pressure, projections of potential recreational demand and an assessment of recreational carrying capacity based on physical, ecological and social constraints should be a routine procedure in the consideration of applications for the extension or establishment of coastal townships.

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APPENDIX 1

QUESTIONNAIRES DISTRIBUTED AT INFANTA -
in English and Afrikaans

UNIVERSITY OF CAPE TOWN

SCHOOL OF ENVIRONMENTAL STUDIES

SURVEY AMONGST HOLIDAYMAKERS AT INFANTA

The information obtained from this questionnaire will be used in a study on coastal township development, for the School of Environmental Studies at the University of Cape Town. Please fill in the questionnaire in your own time and, if you wish, consult with other members of your group when answering questions.

Where boxes are provided, please tick (✓) the appropriate box.

For Office Use Only

SECTION I

1. Are you the owner of the house?

   Yes ☐ No ☐

2. Are you renting this house from the owner?

   Yes ☐ No ☐

3(a) Is this your first visit to Infanta?

   Yes ☐ (If "yes", go to Question 4) No ☐

(b) How often do you visit Infanta for a holiday?

   Less than once a year ☐
   Annually ☐
   Once or twice a year ☐
   More than twice a year ☐

4. Overleaf is a list of reasons people might have for coming to Infanta for a holiday. Please indicate how important each reason is to you when you choose to holiday at Infanta by circling the appropriate number on the five-point scale. Space is provided for other reasons that may be important to you.

P.T.O.

For Office Use Only

	Extremely Important				Not at all Important
Fishing	5	4	3	2	1
Watersports, e.g. swimming, diving, windsurfing	5	4	3	2	1
Boating	5	4	3	2	1
Traditional holiday home	5	4	3	2	1
Conveniently close to home	5	4	3	2	1
Inexpensive holiday	5	4	3	2	1
'Getting away from it all'	5	4	3	2	1
Lack of development	5	4	3	2	1
Sunbathing	5	4	3	2	1
Walking/hiking	5	4	3	2	1
Bird watching	5	4	3	2	1
Attractive scenery	5	4	3	2	1
_____	5	4	3	2	1
_____	5	4	3	2	1
_____	5	4	3	2	1

5(a) If you had no financial constraints, would you still choose to come to Infanta for a holiday?

Yes ☐ (If "yes", go to Question 6) No ☐

(b) If "no", where in South Africa would you prefer to spend a holiday?

Name _____

6. How many people in total are staying in this house during this holiday period?

Number of children 0 - 18 years _____

Number of adults above 18 years _____

7. How many days are the majority of your group spending here this holiday?

Number _____

P.T.O.

For Office Use Only

8. How many vehicles including caravans and motorbikes were used to get all the members of this group to Infanta?

Number of motor vehicles _____

Number of caravans _____

Number of motorbikes _____

9. How many windsurfers, surfboards and canoes were brought to Infanta by members of the group?

Number of windsurfers _____

Number of canoes _____

Number of surfboards _____

0. How many members of your group dive for shell fish?

Number _____

1. How many members of your group go spear fishing when visiting Infanta?

Number _____

2. Does any member of your group own a boat which will be used at Infanta this holiday?

Yes ☐ No ☐ (If "no", go to Question 24)

3. How many boats are there amongst your group?

Number _____

4. Please list the type and length of the boat(s)

Type A _____ Length _____ metres

B _____ _____ metres

C _____ _____ metres

D _____ _____ metres

P.T.O.

For Office Use Only

15. How many engines are used for the boat(s) altogether?

Number _____

16(a) Do the boat(s) stay at Infanta permanently?

Yes ☐ No ☐ (If "no", go to Question 17)

(b) While away from Infanta where is/are the boat(s) kept?

Anchored on the Breede River ☐
On a trailer in the garden ☐
In a garage ☐
Other ☐

17. Do you transport your boat to Infanta for each visit?

Yes ☐ No ☐

18. Do you usually anchor your boat(s) on the Breede River whilst at Infanta?

Yes ☐ No ☐

19. Do you use the boat :

At sea only ☐
At sea and on the river ☐
On the river only ☐

20. (Please tick the appropriate boxes) Do you use the boat for :

Fishing at sea	☐	Fishing in the river	☐	Both	☐
Waterskiing at sea	☐	Waterskiing on the river	☐	Both	☐
Diving at sea	☐	Diving in the river	☐	Both	☐
Birdwatching at sea	☐	Birdwatching on the river	☐	Both	☐
Pleasure trips at sea	☐	Pleasure trips on the river	☐	Both	☐

P.T.O.

For Office Use Only

1. Over the past 10 years has it become increasingly more difficult to catch the same number of fish in the same time spent fishing?

Yes ☐
No ☐
Have not been fishing at Infanta for 10 years ☐

2. Do you still catch the same kind of fish you caught 10 years ago

Yes ☐
No ☐
Not applicable ☐

3. Do you use your boat at Infanta on average :

Everyday ☐
3 to 4 times per week ☐
Once or twice a week ☐
Seldom ☐

4. Do you think the road from the National Road to Infanta should be tarred?

Yes ☐ No ☐

5. If a member of your family or close friend wanted to acquire land to build a house at Infanta, would you support his application?

Yes ☐ No ☐

6. Do you think the existing beach facilities can support more people at peak holiday periods?

Yes ☐ No ☐

7. Do you think a tidal pool should be built at Infanta?

Yes ☐ No ☐

P.T.O.

For Office Use Only

8(a) Would you support an application by a property developer to extend the existing township at Infanta or Infanta Extension One?

Yes ☐ No ☐

(b) Please give brief reasons for your answer :

_____

_____

_____

9. Would you support township development in this area if a tidal pool were built by the developer?

Yes ☐ No ☐

10. What is your attitude towards the caravan park at Infanta? (Please tick only one of the following statements) :

There should be no caravan park at Infanta	☐
The existing caravan park should remain as is	☐
The amenities in the existing caravan park should be improved	☐
The caravan park should be enlarged	☐

11. Which of the following amenities would you like to have access to whilst holidaying at Infanta?

	In favour of	Neutral	Opposed
Post Office	☐	☐	☐
Cafe	☐	☐	☐
Small supermarket	☐	☐	☐
Hotel	☐	☐	☐
Bottle store	☐	☐	☐
ESCOM electricity	☐	☐	☐
Telephone service	☐	☐	☐
Petrol station	☐	☐	☐
Reticulated water	☐	☐	☐
Other : _____	☐	☐	☐
_____	☐	☐	☐

P.T.O.

For Office Use Only

The following is a list of some of the problems facing the Infanta coastal and estuarine environment. Please indicate how serious you consider these problems to be by circling the appropriate number on a five point scale. Space is provided for other problems that you consider serious.

	Most Serious				Least Serious
Overcrowding of beach at Infanta	5	4	3	2	1
Overexploitation of marine resources	5	4	3	2	1
Overexploitation of estuarine bait organisms	5	4	3	2	1
Too many people during peak holiday periods	5	4	3	2	1
Spread of rooikrans (Acacia cyclops)	5	4	3	2	1
Uncontrolled fires	5	4	3	2	1
Shortage of water	5	4	3	2	1
Changing the undeveloped coastal township atmosphere, by introducing modern facilities	5	4	3	2	1
Cleaning fish on the rocks and in the bay	5	4	3	2	1
Boats in the swimming area at Infanta	5	4	3	2	1
Unsafe bathing in the Breede River estuary	5	4	3	2	1
_____	5	4	3	2	1
_____	5	4	3	2	1

If there was an organised expedition to remove alien rooikrans (Acacia cyclops), would you be prepared to participate?

Yes ☐

No ☐

Don't know what rooikrans is ☐

SECTION II

Please fill in the following details :

Name : _____

Permanent Address : _____

_____

For Office Use Only

3. Home Language : _____

4. Sex : _____

5. Occupation : _____

6. If any members of your group live in places other than the permanent residence place given in Question 2 above, please give name of place(s). (Just give name of town or nearest town)

A _____

B _____

C _____

7. If you are not the owner, please give the name and address of the owner of the house you are staying in.

Name : _____

Address : _____

_____

_____

SECTION III

Only to be completed by the owner.

1. On average, how many days is this house occupied per year?

Number : _____

P.T.O.

For Office Use Only

2. At what time of year is this house most frequently occupied? (Please tick the appropriate boxes)

	Often	Occasionally	Never
Christmas and/or New Year	☐	☐	☐
Easter weekend	☐	☐	☐
Other school holidays	☐	☐	☐
Out of season	☐	☐	☐

3. Do you think township development will enhance the value of your property?

Yes ☐ No ☐

4. Would you support property development at Infanta if it enhanced the value of your property?

Yes ☐ No ☐

Thank you for your co-operation. This questionnaire will be collected between the 27th and 29th of December. If you leave Infanta before it has been collected, kindly return the completed questionnaire to the de Villiers home at Infanta (opposite the telephone booth) or post it to Merle Sowman

Environmental Studies Department
University of Cape Town
Private Bag
7700 Rondebosch.

UNIVERSITEIT VAN KAAPSTAD

SKOOL VAN OMGEWINGSLEER

OPNAME ONDER VAKANSIEGANGERS BY INFANTA

Die inligting wat deur middel van hierdie vraelys ingewin word sal in 'n studie oor die ontwikkeling van kustelike woongebiede gebruik word. Die studie word vir die Skool van Omgewingsleer, Universiteit van Kaapstad, onderneem. Vul asseblief hierdie vraelys op u gemak in, en raadpleeg ander lede van u groep om vrae te beantwoord indien u wil.

Waar blokkies verskaf word, plaas asseblief 'n regmerkie (✓) in die gepaste blokkie.

AFDELING I

1. Is u die eienaar van die huis?

   Ja ☐ Nee ☐

2. Huur u die huis van die eienaar?

   Ja ☐ Nee ☐

3(a) Is hierdie u eerste besoek aan Infanta?

   Ja ☐ (Indien, "ja" gaan na Vraag 4) Nee ☐

(b) Gemiddeld, hoe dikwels hou u vakansie op Infanta?

   Minder as eenkeer per jaar ☐
   Jaarliks ☐
   Een of tweekeer per jaar ☐
   Meer as tweekeer per jaar ☐

4. Hier volg 'n lys van redes waarom mense Infanta mag besoek om vakansie te hou. Dui asseblief aan hoe belangrik elk in u geval is wanneer u besluit om 'n vakansie op Infanta deur te bring, deur die gepaste syfer op die vyfpunt-skaal te omring. Ruimte word verskaf om ander redes wat vir u belangrik mag wees, aan to vul.

	Uiters Belangrik				Van geen belang
Visvang	5	4	3	2	1
Watersport, bv. swem, duik, seilplankry	5	4	3	2	1
Bootry	5	4	3	2	1
Tradisionele vakansiehuis	5	4	3	2	1
Gerieflik naby aan die huis	5	4	3	2	1
Ekonomiese vakansie	5	4	3	2	1
'Om van alles weg te kom'	5	4	3	2	1
Afwesigheid van ontwikkeling	5	4	3	2	1
Sonbaai	5	4	3	2	1
Stap/wandel	5	4	3	2	1
Voëlwaarneming	5	4	3	2	1
Aantreklike landskap	5	4	3	2	1
_____	5	4	3	2	1
_____	5	4	3	2	1

5(a) Indien daar geen finansiële perke van toepassing op u was nie, sou u nog steeds kies om op Infanta vakansie te hou?

Ja ☐ (Indien "ja", gaan na Vraag 6) Nee ☐

(b) Indien "nee", waar, in Suid Afrika, sou u verkies om vakansie te hou?

Naam van plek _____

6. Hoeveel mense in totaal bly in hierdie huis gedurende hierdie vakansie tydperk?

Aantal kinders 0 - 18 jaar _____

Aantal volwassenes oor 18 jaar _____

7. Hoeveel dae sal die meeste van u groep hierdie vakansie hier deurbring?

Aantal dae _____

8. Hoeveel voertuie (karavane en motorfietse ingesluit) is gebruik om al die lede van u groep tot op Infanta te bring?

Aantal voertuie _____

Aantal karavane _____

Aantal motorfietse _____

9. Hoeveel seilplanke, branderplanke en kano's is deur lede van u groep Infanta toe gebring?

Aantal seilplanke _____

Aantal kano's _____

Aantal branderplanke _____

10. Hoeveel lede van u groep duik vir skulpvis?

Aantal _____

11. Hoeveel lede van u groep neem deel aan visskietery terwyl op Infanta?

Aantal _____

12. Is enige lid van u groep die eienaar van 'n boot wat gedurende hierdie vakansie te Infanta gebruik sal word?

Ja ☐ Nee ☐ (Indien "nee", gaan na Vraag 24)

13. Hoeveel bote is daar onder u groep?

Aantal _____

14. Noem asseblief die soort en lengte van die boot (bote) :

Soort A _____ Lengte _____ m

B _____ _____ m

C _____ _____ m

15. Hoeveel enjins word altesame vir die boot (bote) gebruik?

Aantal _____

16(a) Word die boot (bote) permanent op Infanta gehou?

Ja ☐ Nee ☐ (Indien "nee", gaan na Vraag 17)

(b) Waar word die boot (bote) gebêre terwyl u weg is van Infanta?

Geanker op die Breërivier ☐
Op 'n sleepwa in die tuin ☐
In 'n motorhuis ☐
Ander ☐

17. Vervoer u u boot (bote) na Infanta met elke besoek?

Ja ☐ Nee ☐

18. Anker u gewoonlik u boot (bote) op die Breërivier terwyl u op Infanta is?

Ja ☐ Nee ☐

19. Gebruik u die boot

Slegs op die see ☐
Op die see en op die rivier ☐
Slegs op die rivier ☐

20. (Plaas asseblief 'n regmerkie in all gepaste blokkies)

Waarvoor word die boot gebruik?

Visvang op see	☐	Visvang op rivier	☐	Albei	☐
Waterski op see	☐	Waterski op rivier	☐	Albei	☐
Duik in see	☐	Duik in rivier	☐	Albei	☐
Voëlwaarneming op see	☐	Voëlwaarneming op rivier	☐	Albei	☐
Plesierritte op see	☐	Plesierritte op rivier	☐	Albei	☐

21. Het dit oor die afgelope 10 jare geleidelik moeiliker geword om dieselfde aantal visse, in dieselfde tyd bestee aan visvang, te vang?

Ja ☐
Nee ☐
Het minder as 10 jaar op Infanta kom visvang ☐

22. Vang u nog steeds dieselfde soorte vis as wat u 10 jare gelede gevang het?

Ja ☐
Nee ☐
Nie van toepassing nie ☐

23. Gebruik u u boot op Infanta gemiddeld

Elke dag? ☐
3 tot 4 keer per week ? ☐
1 of 2 keer per week? ☐
Selde? ☐

24. Dink u dat die pad vanaf die Nasionale Pad tot op Infanta geteer moet word?

Ja ☐ Nee ☐

25. Indien 'n familielid of goeie vriend van u 'n erf wou bekom om 'n huis op Infanta te bou, sou u sy aansoek ondersteun?

Ja ☐ Nee ☐

26. Dink u dat die huidige strandfasiliteite meer mense teen spits vakansietye kan ondersteun?

Ja ☐ Nee ☐

27. Dink u dat 'n getypoel op Infanta behoort gebou te word?

Ja ☐ Nee ☐

28(a) Sou u 'n aansoek deur 'n eiendomsontwikkelaar om die huidige Infanta woongebied uit te brei ondersteun?

Ja ☐ Nee ☐

(b) Gee asseblief kort redes vir u antwoord

_____

_____

29. Sou u die uitbreiding van die Infanta woongebied ondersteun indien 'n getypoel deur die ontwikkelaar gebou sou word?

Ja ☐ Nee ☐

30. Wat is u houding teenoor die karavaanpark te Infanta? (Merk asseblief net een van die onderstaande) :

Daar behoort nie 'n karavaanpark op Infanta te wees nie	☐
Die bestaande karavaanpark moet bly soos dit is	☐
Die geriewe in die bestaande karavaanpark moet verbeter word	☐
Die karavaanpark moet vergroot word	☐

31. Watter van die volgende geriewe sou u graag op Infanta wou sien?

	Sterk ten Gunste van	Neutraal	Sterk Afkeur
Poskantoor	☐	☐	☐
Kafee	☐	☐	☐
Klein supermark	☐	☐	☐
Hotel	☐	☐	☐
Drankwinkel	☐	☐	☐
Elektrisiteit (EVKOM)	☐	☐	☐
Telefoondiens	☐	☐	☐
Watervoorsiening	☐	☐	☐
Vulstasie	☐	☐	☐
Ander _____	☐	☐	☐
_____	☐	☐	☐

32. Hier volg 'n lys van sommige probleme waarmee die Infanta omgewing te kampe het. Dui asseblief aan hoe ernstig (na u mening) die probleme is, deur die gepaste syfer op die vyfpunt-skaal te omring. Ruimte word verskaf om ander probleme wat vir u belangrik mag wees, aan to vul.

	Uiters Ernstig				Geen Probleem
Oorbevolking van die strandgebied by Infanta	5	4	3	2	1
Oorbenutting van seëbronne	5	4	3	2	1
Oorbenutting van riviermond aas-organismes	5	4	3	2	1
Te veel mense gedurende spits vakansietye	5	4	3	2	1
Indringing van rooikrans (Acacia cyclops)	5	4	3	2	1
Onbeheerde brande	5	4	3	2	1
Tekort aan water	5	4	3	2	1
Verandering van die atmosfeer van 'n onontwikkelde kustelike woongebied deur die invoer van moderne fasiliteite	5	4	3	2	1
Skoonmaak van vis op rotse en in die baai	5	4	3	2	1
Bote in die swemgebied by Infanta	5	4	3	2	1
Gevaarlik om in die riviermond te swem	5	4	3	2	1
_____	5	4	3	2	1
_____	5	4	3	2	1

3. Indien 'n uitstappie gereël sou word om die uitheemse rooikrans (Acacia cyclops) uit te kap, sou u bereid wees om deel te neem?

Ja ☐

Nee ☐

Weet nie wat rooikrans is nie ☐

AFDELING II

Vul asseblief die volgende besonderhede in :

1. Naam : _____

2. Permanente Adres : _____

_____

_____

3. Huistaal : _____

4. Geslag : _____

5. Beroep : _____

6. Indien enige lede van u groep op ander plekke as die permanente woonadres genoem in Vraag 2 bly, noem asseblief die name van hulle woonplekke (gee slegs naam van dorp of naaste dorp)

A _____

B _____

C _____

7. As u nie die eienaar van die huis is nie, gee asseblief die naam en adres van die eienaar.

Naam : _____

Adres : _____

_____

_____

AFDELING III

Moet slegs deur die eienaar voltooi word.

1. Gemiddeld, ongeveer hoeveel dae per jaar word hierdie huis gebruik?

Aantal dae _____

2. Teen watter tyd van die jaar word hierdie huis mees dikwels bewoon? (Merk die gepaste blokkies)

	Dikwels	Soms	Nooit
Kersfees en/or Nuwejaar	☐	☐	☐
Paasnaweek	☐	☐	☐
Ander skoolvakansies	☐	☐	☐
Buite seisoen	☐	☐	☐

3. Dink u dat uitbreiding van die woongebied die waarde van u eiendom sal verbeter?

Ja ☐ Nee ☐

4. Sou u eiendomsontwikkeling by Infanta ondersteun indien dit die waarde van u eiendom sou verbeter?

Ja ☐ Nee ☐

Dankie vir u samewerking. Die vraelys sal tussen 27 en 29 Desember by u afgehaal word. Indien u Infanta verlaat voordat dit afgehaal is, lewer die vraelys asseblief af by die huis van die de Villiers gesin (teenoor die telefoonhokkie) of pos aan

Merle Sowman
Skool van Omgewingsleer
Universiteit van Kaapstad
7700 Rondebosch

APPENDIX 2

MODIFICATIONS TO QUESTIONNAIRES DISTRIBUTED AT THE CARAVAN PARK

1. Omit Questions 1 and 2.

2. In Question 4 change 'Traditional holiday home' to 'Traditional holiday place'.

3. Change Question 6 to: 'How many people in total are there in your camping group?'

4. In Question 16(b) omit 'On a trailer in the garden' and 'In a garage.'

5. Omit Question 7 in Section II.

6. Omit Section III.

(These changes were also made on the Afrikaans questionnaires)

APPENDIX 3

MODIFICATIONS TO QUESTIONNAIRES DISTRIBUTED ALONG THE SOUTH BANK OF THE BREEDE RIVER ESTUARY

1. Change the title of the questionnaire to: 'SURVEY AMONGST HOLIDAYMAKERS ALONG THE SOUTH BANK OF THE BREEDE RIVER ESTUARY'.

2. Throughout the questionnaire change 'Infanta' to 'the Breede River estuary' except in Question 27.

3. Reword Question 23 to: 'Whilst holidaying at the Breede River estuary do you use your boat on average ...'.

4. Change the final paragraph of the questionnaire to: 'Thank you for your co-operation. If you leave the Breede River estuary before the questionnaire has been collected, kindly return it to me in the stamped envelope provided'.

(These changes were also made on the Afrikaans questionnaire)

APPENDIX 4

An example of the data sheet used to record daily observations during the peak holiday periods from 25 December 1983 - 5 January 1984 and over the Easter weekend, April 1984.

Location: Infanta slipway Date: 21-04-84 Time: 11h00

Weather: sunny, moderate S.E. wind 5-10 knots

	Number
No. of ski-boats sighted in St Sebastian Bay	15
No. of ski-boat trailers parked on commonage	16
No. of people : Boardsailing	3
: Canoeing	0
: Paddleskiing	1
: Surfing	3
: Swimming	15
: Diving/Snorkelling	3
: Sunbathing	95
: on the beach	110
: fishing off rocks	7
: collecting bait and shellfish	3

Other: 2 spearfishermen preparing to go diving.

APPENDIX 4 - Continued

Location: Prawn Beds Date: 21-04-84 Time: 3h00

Weather: sunny, strong S.E. wind. 20 - 25 knots.

	Number
No. of boats on estuary	18
No. of boats used for fishing on estuary	12
No. of boats anchored at Bar Harbour	6
No. of boats anchored alongside prawn beds	10
No. of people : fishing from boats	32
: fishing from shore	5
: collecting bait	20
: using prawn pumps	13
: boardsailing	7
: canoeing and rowing	1
: swimming	2
: sunbathing	12
: walking	15
: braaing	0
: waterskiing	0

Other:

APPENDIX 5

SKI-BOAT CATCH AND BAIT COLLECTION RECORD
CARDS DISTRIBUTED TO SPORT ANGLERS

SKIBOOT VISVANGSTE / SKI-BOAT CATCH RECORD

E.D.P. 12

LOCALITY PLEK		DATUM DATE	19
TIME: FROM TYD: VAN	TO TOT	KLUB OF VERENIGING ? CLUB OR ASSOCIATION ?	
NO. ANGLERS IN BOAT ? AANTAL HENGELAARS IN BOOT ?		BOOT CODE ? BOAT CODE ?	

	SPECIES SPESIES	NO.	TOTAL KG. TOTAAL KG.

	SPESIES SPECIES	NO.	TOTAAL KG. TOTAL KG.

COMMENTS
OPMERKING

AASVERSAMELING REKORD/BAIT COLLECTION RECORD

Where collected or bought Waar versamel of gekoop				Date Datum	04 1984
Time Tyd	From Van		To Tot		No. bait collectors Aantal aasversamelaars
Instrument used to collect bait Instrument gebruik om aas to versamel					

	Species	No

	Species	No

Comments:
Opmerkings:

APPENDIX 6

AERIAL PHOTOGRAPHS USED IN THIS STUDY

Job No.	Photo. No.	Date	Approx. Scale
17042	04926	1942	1:32 000
17042	03960	1942	1:32 000
344	016	03/04/1954	1:30 000
344	015	03/04/1954	1:30 000
564	278	08/05/1967	1:40 000
564	278	08/05/1967	1:40 000
735	9718	05/1974	1:50 000
735	9720	05/1974	1:50 000
498/178	653	09/04/1981	1:30 000
498/178	656	09/04/1981	1:30 000

All aerial photographs were obtained from the Directorate of Surveys and Mapping, Department of Public Works and Land Affairs, Mowbray, Cape Town.

APPENDIX 7

LETTER ATTACHED TO FISH LISTS SENT TO SPORT ANGLERS FOR COMMENT

UNIVERSITY OF CAPE TOWN

(WITH WHICH IS INCORPORATED THE SOUTH AFRICAN COLLEGE)

TELEPHONE (021) 698531
TELEGRAMS "ALUMNI CAPE TOWN"
TELEX 57-22208

UNIVERSITY PRIVATE BAG
RONDEBOSCH, 7700
SOUTH AFRICA

SCHOOL OF ENVIRONMENTAL STUDIES

14 May 1984

Dear Sir

I am doing research on the effects of increased human pressure along the Cape coastal and estuarine area. One aspect of the study is to investigate the effect of sport fishing in the area to determine whether increased human pressure has reduced the numbers of fish in the area or changed their species composition.

If you have any fish catch records since you or your family began fishing in the area I would be grateful if you would allow me to study them.

However, if you have not kept any formal catch records please read through the enclosed species list of fish for the Breede River estuary, which was compiled by a team of marine biologists from the Estuarine and Coastal Research Unit and the National Research Institute for Oceanography. This list was published in the Breë River Estuary Report of December 1983. This list also includes the direct observations and angling records from the Cape Infanta area of Mr P Zoutendyk, a marine biologist and one of the property owners of Witklip Estates.

I would be grateful if you would:-

1) Add to the list any species you have caught that have not been listed.
2) Delete in pencil any fish species that you feel have been incorrectly listed stating reasons for your deletion.
3) Complete where possible columns 3-Status and 4-Remarks.

Status should be recorded as one of the following:- abundant; very common; common; present; rare; no longer present or not recorded for the past x years. Put a value on x.

Remarks : Any comments relating to size, frequency and distribution of fish caught would be most useful. Size of largest fish recorded and date caught, whether numbers of a particular species have declined or increased over time and whether fish previously caught from the rocks are now only caught offshore by boats are the kinds of comments that would be valuable.

I realise this may be a time-consuming task but your information will add considerable value to the present meagre information on the fish records of the area.

If you wish to discuss the nature of my research, I can be contacted at work at 69-8531 extension 186.

Yours faithfully

MR Sowman

Merle Sowman

APPENDIX 8

Catch per unit effort data for each boat, based on fish catch cards returned after the Easter weekend, April 1984. The final column gives CPUE expressed both as number and mass (mass values in brackets) of fish caught per man-hour.

	Time in hours	No. Anglers	No. Fish	Total Mass (kg)	No. (mass in kg)/ man/hour	
1	7	4	12	23,5	0,43	(0,84)
2	9	4	63	400,0	1,75	(11,11)
3	8,5	3	68	63,0	2,67	(2,47)
4	7	3	115	164,0	5,48	(7,81)
5	5	3	80	75,0	5,33	(5,0)
6	3	2	12	3,8	2,0	(0,63)
7	4	5	65	50,0	3,25	(2,5)
8	3	3	35	21,0	3,89	(2,33)
9	2	3	0	0	0	(0)
10	6	4	28	52,0	1,17	(2,17)
11	6	2	38	43,0	3,17	(3,58)
12	5	4	20	25,0	1,0	(1,25)
13	6,5	5	36	137,0	1,11	(4,22)
14	6	3	43	17,0	2,39	(0,94)
15	3	2	5	1,6	0,83	(0,27)
16	2	2	3	1,0	0,75	(0,25)
17	4	3	8	6,75	0,67	(0,56)